

STUDIES IN AUSTRALIAN NEUROPTERA.

NO. iv. THE FAMILIES *ITHONIDÆ*, *HEMEROBIIDÆ*, *SIYRIDÆ*,
BEROTHIDÆ, AND THE NEW FAMILY *TRICHOMATIDÆ*; WITH
 A DISCUSSION OF THEIR CHARACTERS AND RELATIONSHIPS,
 AND DESCRIPTIONS OF NEW AND LITTLE-KNOWN GENERA AND
 SPECIES.

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(Plates xii.-xix., and ten Text-figs.)

INTRODUCTION.

In No.2 of this series of Studies,* I dealt with the families *Osmyloidæ*, *Myrmeleontidæ*, and *Ascalaphidæ*. There remained over for study a large number of the smaller and more generalised Neuroptera, usually included more or less loosely in the family *Hemerobiidæ*. The working-out of this material, contained chiefly in my own collection, but augmented by the loan of specimens from the Queensland Museum, Brisbane, and from Mr. Froggatt's collection, has proved a difficult and protracted task. It would not, indeed, have been difficult to offer merely descriptions of new species, for the great majority of the species studied were new to science. The problem lay rather in attempting to form a conception of the true positions occupied by the smaller "Lacewings" within the Order Neuroptera. I was faced, at the start, with the fact that the family *Hemerobiidæ* had never been clearly defined from the very outset; that, as limb after limb had been chopped off from the old Hemerobiid tree (which originally embraced the whole of the Order Neuroptera, as we now accept it), the old hollow stump had become more and more the receptacle for any remnants which would not fit clearly into

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any of the numerous well-defined families cut off from it. I found, everywhere, that there seemed to exist no scientific conception of what the family *Hemerobiidae* meant; no attempt has been made to study its venation thoroughly; and the authors, who used the family, either offered short, non-committal definitions, which utterly ignored the fundamental characters of wing-venation [see, for instance, Sharp(13), p.465], or merely used the name as a headline under which various genera might be placed, without troubling themselves why or wherefore. It was, therefore, of the utmost importance to carry out a thorough investigation of the venation of the genus *Hemerobius* and its true allies, and to discover a clear and comprehensive definition for the family *Hemerobiidae*, which should not only embrace all the members of one natural group, but should also exclude the extraneous material that had, for so long a time, been allowed to drift in and out of the family, with no apparent reason, other than neglect of the fundamental principles of classification.

The results of a close study of all the forms available to me were originally collected together with a view to publication as an extended introduction to this paper. I found, however, that it would be necessary to refer back continually to the general discussion, when I came to deal with the separate families. In order, then, to save much repetition, I have decided to give the main arguments *under each separate family*, where they will now be found. Those who desire to trace the fate of the family *Hemerobiidae*, its gradual narrowing down, and my own attempt to give it definite form and function, as a unit embracing only genera having true phyletic relationship with the type-genus *Hemerobius*, will find their information under this particular family, on pp.282-293. Similarly, the vagaries suffered by *Ithone* and *Sisyra* will be found under *Ithonidae* (pp.274-279) and *Sisyridae*(pp.312-313), together with analyses of the types of wing-venation found in these families. In dealing with *Spermophorella*, gen.nov., I had to choose between forming a new family for it, or including it within the Holarctic *Berothidae*. I chose the latter, for the reasons given on pp.315-316. No apology is needed for the formation of the new family *Trichomatidae* (pp.324-325),

since the two new genera forming it differ most strikingly from all known Neuroptera.

The forms studied included also the beautiful genus *Psychopsis*, usually placed in the *Hemerobiidæ*, but already recognised by N. Banks and Handlirsch as entitled to at least subfamily rank. The discovery of the complete life-history of one species of this genus, and the opportunity of examining the habits of the living larvæ, pupæ, and imagines, has so strengthened the conviction (which I had already gained from a study of the venation), that this group has nothing whatever to do with the *Hemerobiidæ*, that I have cut it out of this paper, preferring to deal with it as a separate family, *Psychopsidæ*, in a monograph to follow later.

The only true allies of the *Hemerobiidæ*, as restricted by me, are the *Ithonidæ* and *Dilaridæ*, the latter not found in Australia. These three families might well be placed together as constituting the Sub-Order Hemerobioptera, constituting the only remains of a single phyletic line of descent, defined by the exceedingly ancient character of the possession of more than one radial sector in the forewing. This character, though it may have occurred more frequently in the past, in groups now extinct (as, for example, in the Protodonata), appears to be quite lost in other recent Insecta, a reduction to a single radial sector being the almost universal rule. Its persistence in the Hemerobioptera is correlated with the retention of an ancient wing-form and venational scheme. Narrowing or lengthening of the wing would require the elimination of the extra sectors; but the Hemerobioptera on the whole, though undergoing, through the course of ages, extreme reduction in size, have retained a very uniform and unspecialised venational pattern.

Distinguished from these by the possession of a single radial sector in the forewing, the whole of the rest of the Order Neuroptera stand out as an Osmyloid stock, and might fittingly form a Sub-Order Osmyloptera. These insects, though probably not in the main aquatic in their life-histories, have been continually throwing off aquatic or semi-aquatic remnants, while the great mass of forms progressed rapidly onwards along the more successful lines offered by the rapacious, terrestrial, carnivorous,

larval habit. Thus we have, as semi-aquatic offshoots, the Liassic and Jurassic *Prohemerobiidæ*, the recent *Osmyloidæ* (some semi-aquatic, some terrestrial), and the highly-reduced *Sisyridæ*, whose larvæ dwell in freshwater sponges. From the first of these, our Australian *Psychopsidæ* undoubtedly arose, by a unique specialisation of the wing-venation, and by the adoption of a larval habit closely resembling that of the Raphidians in the Northern Hemisphere. From the *Osmyloidæ*, a small, terrestrial side-branch, the *Nymphidæ*, favoured by an exceptionally fortunate larval development, started out on the upward path which led to the great dominant groups of the *Myrmeleontidæ* and *Ascalaphidæ*. A small side-branch of the *Prohemerobiidæ*, the Jurassic *Mesochrysopidæ*, probably gave rise to the modern *Apochrysidæ* and *Chrysopidæ*. The highly-reduced remnant of the main stem, after throwing off the aquatic *Sisyridæ*, reached the extreme limits of reduction in the *Coniopterygidæ*. The positions of the *Nemopteridæ* and *Mantispidæ* are uncertain, but the former are probably allied to the *Nymphidæ*, the latter to the *Chrysopidæ*.

We see, then, that of the five families dealt with in this paper, only two are of the true Hemerobioid stock, while the other three possess Osmyloid affinities. The resemblance between *Hemerobiidæ* and *Sisyridæ* is purely due to convergent reduction, both these families being specialised in comparison with the other three, though generalised enough when contrasted with the more dominant groups, such as the *Chrysopidæ*. Of the three most ancient families, the *Ithonidæ* appear to possess traces of Sialoid affinities, while the *Berothidæ* and *Trichomatidæ* must not only stand very close to the base of the Neuropteroid stem, but may even lie not far off from the more specialised line which led to the *Micropterygidæ* in the Lepidoptera. Lepidopterists cannot, indeed, afford to ignore the growing importance of the Neuroptera in helping them to a true view of the phylogeny of their Order. In this connection, the scales on the wings of *Berothidæ*, the fringe of long hairs in this family and in the *Trichomatidæ*, the very obvious resemblance between the venation of the *Micropterygidæ* and the most highly reduced Neuroptera (*Coniop-*

terygidae), and the persistence of a coupling apparatus for the wings, homologous with that of the Frenate Lepidoptera, in all but the most reduced forms of these archaic families, ought to be sufficient to attract their attention from the more humdrum duties of classifying and describing an immense mass of new forms.

The following is a list of the families, genera, and species dealt with in this paper :—

Family ITHONIDÆ, fam. nov.

Genus ITHONE Newman. (Type, *I. fusca* Newm.).

1. *Ithone fusca* Newman.

2. *Ithone fulva*, n.sp.

Family HEMEROBIIDÆ (a me restricta).

Genus DREPANEPTERYX Burm. (Type, *D. phalenoïdes* Linn.).

[*D. phalenoïdes* Linn.]

Genus DREPANACRA, n.g. (Type, *Drepanepteryx humilis* McLach).

3. *Drepanacra humilis* McLach.

4. *Drepanacra instabilis* McLach.

5. *Drepanacra binocula* Newman.

6. *Drepanacra hardyi*, n.sp.

7. *Drepanacra froggatti*, n.sp.

Genus DREPANOMINA, n.g. (Type, *D. gibbosa*, n.sp.).

8. *Drepanomina gibbosa*, n.sp.

Genus MEGALOMINA Banks. (Type, *M. acuminata* Banks).

9. *Megalomina acuminata* Banks.

Genus OXYBIELLA, n.g. (Type, *O. bridwelli*, n.sp.).

10. *Oxybiella bridwelli*, n.sp.

Genus PSYCHOBIELLA Banks. (Type, *Ps. sordida* Banks).

11. *Psychobiella fusca*, n.sp.

Genus MICROMUS Rambur. (Type, *M. variegatus* Fabr.).

12. *Micromus tasmanice* Walker.

Genus NOTIOBIELLA Banks. (Type, *N. unita* Banks).

13. *Notiobiella viridis*, n.sp.

14. *Notiobiella multifurcata*, n.sp.

Genus CAROBIUS Banks. (Type, *C. pulchellus* Banks).

15. *Carobius subfasciatus*, n.sp.

Family SISYRIDÆ.

Genus SISYRA Burm. (Type, *S. fuscata* Fabr.).

16. *Sisyra turneri*, n.sp.

17. *Sisyra rufistigma*, n.sp.

Family BEROETHIDÆ.

Genus SPERMOPHORELLA, n.g. (Type, *Sp. disseminata*, n.sp.).

18. *Spermophorella disseminata*, n.sp. (also egg and larva).

19. *Spermophorella maculatissima*, n.sp.

Family TRICHOMATIDÆ, fam.nov.

Genus TRICHOMA, n.g. (Type, *T. gracilipennis*, n.sp.).

20. *Trichoma gracilipenne*, n.sp.

Genus STENOBIELLA, n.sp. (Type, *St. hirsutissima*, n.sp.).

21. *Stenobiella hirsutissima*, n.sp.

22. *Stenobiella gallardi*, n.sp.

A list of all publications referred to during the writing of this paper is placed at the end in the form of a Bibliography. References to this are printed in thick type.

I desire to thank Dr. A. J. Turner, F.E.S., of Sherwood, Brisbane, Mr. G. Hardy, F.E.S., of the Tasmanian Museum, Hobart, Mr. O. Lower, F.E.S., of Broken Hill, and Mr. J. C. Bridwell, of Honolulu, for rare specimens dealt with in this paper, and received from them either by gift or by exchange; also Dr. R. Hamlyn-Harris, Director of the Queensland Museum, Brisbane, and Mr. W. W. Froggatt, F.L.S., F.E.S., New South Wales Government Entomologist, for the loan of material for study.

Family ITHONIDÆ, fam.nov. (Plate xii.)

Rather large insects, expanse 45-50 mm., with stout body, broad, short, sessile prothorax, and small head closely united with it; *antennæ* of moderate length and stoutness, tapering, very finely pectinate, with numerous close-set cylindrical joints; *ocelli* absent. *Wings* smooth, membranous, semitrans-

parent, the hairs on the veins very minute; surface of forewing not a plane, Sc being sunk in a deep furrow, and R raised up on a high ridge above it; M lying in a deep furrow, and Cu₁ raised on a high ridge, which is partly continued by M₂. The same ridges and furrows on the hindwing, but the ridge of Cu₁ straighter, and not continued by M₂. Sc and R not fused distally. Three radial sectors in forewing, two arising close to base, unbranched, a third arising a little distad from these, running parallel to and under R, and giving off numerous branches. In hindwing, only one radial sector, with numerous branches. M branching into two at a level about one-third of the wing-length in both wings. Cu branching into two close up to base in both wings. Numerous irregularly placed cross-veins present. Costal area of forewing slightly enlarged, a recurrent veinlet present, the other crossveins seldom forked. A coupling apparatus well developed, but without a specialised frenulum on the jugal process. A well-developed false origin to Rs in the hindwing.

I propose this new family for the reception of the very isolated and peculiar, archaic, Australian genus *Ithone*, whose relationships have long been a puzzle to entomologists. Two of the most striking characteristics of this genus are (1) its resemblance, when alive, both in general appearance and behaviour, to a Hepialid moth, the mode of flight (especially when attracted to a light), the resting position, and the form of the head and body all contributing to heighten this similarity; and (2) its undeniable similarity to the *Sialidae*, the family in which Walker placed it. As the life-history is quite unknown, we cannot even guess what the larva may be like; but, as will be seen below, I have collected evidence tending to show that it may be aquatic or semi-aquatic. The strong ridging of the wings along R and Cu is most certainly a Sialoid character; and it must be confessed that the term Planipennia is quite unsuited to the Order which contains this genus. But a study of the venation will convince us that *Ithone* belongs to the Neuroptera, s.str., and not to the Megaloptera (*Sialidae*), since the arrangement of all the main veins and their branches is typically Neuropterous. I should

like, however, to point out that, in my opinion, *Ithone* stands not very far from the point at which the Megaloptera may be supposed to have diverged from the main Neuropteroid stem, and that it is quite possible that the larva may be of a generalised type, and not possessing the sucking mandibles of the true Neuroptera. If this be so, we must perhaps consider the separation of the Order Megaloptera from the true Neuroptera to be unwarranted.

The character which seems to me to be of the greatest importance in this family is the peculiar generalised condition of the radius and its branches in the forewing. Naming the three radial sectors R_2 , R_3 , and R_4 , respectively, from the most distal backwards towards the base, there can be little doubt that it is R_2 , with its course laid parallel to and beneath R_1 (the main stem of the radius), and with its numerous subparallel branches, which is the true homologue of the single Rs, found in all Neuroptera except the *Hemerobiidae*, *Dilaridae*, and *Ithonidae*. The two sectors, R_3 and R_4 , arising closer to the base of R, are strongly suggestive of an archaic formation, which we know occurred in the forewing of the great Protodonate *Meganевра* (Upper Carboniferous), and which was once probably of frequent occurrence in archaic unreduced types with 'dense venation. Not a trace of these two sectors exists in recent Odonata, in which the specialisation of the wing-venation appears to have set in earlier, and to have been of a far more drastic character, than we find in the Neuroptera. In the Odonata, the wing is essentially *utilitarian*, the last word in the development of a magnificent flying type. In the Neuroptera, on the other hand, the wing is, if I may say so, purely *artistic*, a beautiful expression of the development of a symmetrical plan, which conserves almost all the archaic features of the insect-wing, and, as a result, is of little value for strong flight. How the two sectors, R_3 and R_4 , have been eliminated in the newer forms, we are not in a position to determine. Either they have been simply suppressed during progressive simplification of the venation, or they have passed distad on to the base of R_2 , where they would take on the character of branches of the radial sector. In either case,

it is clear that Comstock and Needham's proposition(3), unsupported, as far as I can see, by any evidence, cannot be accepted. This proposition was to the effect that additional sectors of R had been added, one after another, from the distal end, and had thus progressed gradually basad. Now the whole study of Neuropterous venation emphasises the fact that the tendency of branches of R (and of M and Cu likewise) is to move progressively distad, as we pass from the older to the newer forms. Again, if Comstock and Needham were correct, the old original Rs, with its many branches, would have to be the most basally placed, whereas it is actually the most distally placed in all three families where more than one sector exists. Thirdly, Comstock and Needham's proposition would necessitate a recognition of the smallest simplified *Hemerobiidae*, with only two sectors, as archaic types, from which, by progressive elaboration of the venation, the forms with many sectors (such as *Drepanopteryx*, *Megalomus*) have been built up; whereas it must be obvious, to the most superficial student of the Order, that the very opposite is the case. The only argument in favour of Comstock and Needham's proposition is the fact that fossil Neuroptera, so far as they are known, all have a single Rs in the forewing. But the only fossils known, other than those of Tertiary age, are a small group of forms from the Upper Lias and Upper Jurassic (the *Prohemerobiidae* of Handlirsch, together with one or two other forms) which are clearly allied to our *Osmylidae* and *Psychopsidae*, and show already, in the Lias, a degree of specialisation which places them very far from the beginning of the Neuropteroid stock. Nobody would claim, I suppose, that such an admittedly archaic group as the Neuroptera arose in the Lias, or even in the Trias. It must have been already in existence alongside the Carboniferous Protodonata, these latter being, in fact, a very vigorous side-branch of the main stem, specialising in the assumption of an aquatic larval life-history. Why, then, have we so small a record of fossil Neuroptera? The answer is obvious, viz., that they have all along been essentially a non-aquatic group, with a preference for dry climates. We cannot hope, then, to find their record written completely in freshwater beds,

nor can we ever expect that the ancestry of any part of them is preserved for us in fossils, except that of the semi-aquatic *Osmylidæ* and their nearest allies. As for the *Hemerobiidæ*, essentially a forest-dwelling group, we should expect to find them in Baltic amber (where several species do occur), but to look for their ancestors in freshwater or estuarine deposits, such as those at Solenhofen, is unreasonable, since they were neither aquatic, semi-aquatic, nor strong-flying, as far as we are able to judge.

I conclude, therefore, that the *Ithonidæ* are an exceedingly archaic remnant of the old Neuropteroid stock, from which, later on, the *Dilaridæ* (with only two sectors) branched off, and whose main stem is represented to-day in the more highly reduced *Hemerobiidæ*. Apart from these three families, all the rest of the Neuroptera, with their single radial sector, must be considered as a more recent and highly specialised stock, of which the *Osmylidæ* and their near allies stand closest to the ancestral form, and from which the *Myrmeleontidæ*, *Ascalaphidæ*, *Chrysopidæ*, and *Mantispidæ* arose, as the most vigorous and dominant offshoots.

The nearest relatives of the *Ithonidæ* are undoubtedly the *Dilaridæ* (not found in Australia), which may be distinguished by their smaller size, slenderer build, the strongly pectinate antennæ of the male, the presence of a large ovipositor in the female; and, in the venation, the lack of strong ridging of R and Cu₁, the possession of only two radial sectors in the forewing, and the presence of fewer unspecialised crossveins.

Genus *ITHONE* Newman. (Plate xii.).

Newman, Ent. Mag., v., 1838, p.181.

Characters as given above for the family, with the following additions:—No setæ or fine hairs on any of the crossveins except the costals. *Forelegs* placed close under the head, with the coxæ much enlarged and close together (Plate xii., fig.2). *Tibie* of all legs with a pair of short spurs. *Tarsi* five-jointed, the basal joint very long, a large bilobed *empodium* between the claws. *Anal appendages* of male strongly forcipate.

Genotype, *Ithone fusca* Newman.

The two known species of the genus may be separated as follows :—

- Larger and darker species, expanse 50 mm. or more, colouration fuscous; antennæ about half as long as forewing; appendages of male enormous..... *I. fusca* Newman.
 Smaller, less robust and paler species, expanse 45 mm., colouration dull fulvous; antennæ two-thirds as long as forewing; appendages of male of moderate size..... *I. fulva*, n.sp.

1. *ITHONE FUSCA* Newman. (Plate xii., figs.7-9).

Newman, *loc. cit.*, p.181.

This species appears to be well known, and represented in a number of collections, but I have not seen any good description or figure of it published. Newman's description of it is very short, but quite to the point:—"Fusca, setosa, subtus dilutior et paullo flavescens, alæ fuscæ, venæ longitudinales setis tectæ, transversæ nisi supracostales nudæ." The general appearance is much like that of *I. fulva*, n.sp., as figured in Plate xii., fig.1, but the whole body is stouter, hairier, and darker, the antennæ shorter, thicker, and darker in colour, the wings broader and much darker. The appendages of the male are very remarkable, being in the form of an immense pair of forceps of very peculiar shape; the dorsal, profile, and posterior views are shown in Plate xii., figs.7, 8, and 9 respectively.

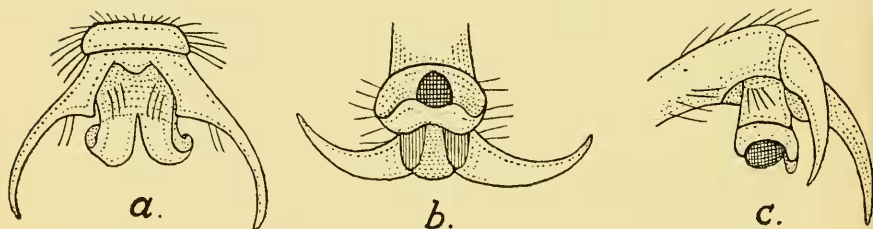
Hab.—Sydney District, N.S.W., where it appears to be at present very rare. I have a male and female taken at light in my house at Hornsby, but they are the only specimens that I have seen in the course of many years collecting. I also have some torn pieces of the wings of a specimen sent from Tasmania, but almost completely destroyed in the post, which probably belong to this species. It has also been recorded from Western Australia, but I do not know whether this is really the same species.

2. *ITHONE FULVA*, n.sp. (Plate xii., figs.1-6).

♂. *Total length* 17, *abdomen* 11·5, *forewing* 21, *hindwing* 18·5, *expanse* 45 mm.

Head: *eyes* button-like, shining black, wide apart; *antennæ* 14 mm., filiform, tapering, dull fulvous; *epicranium* brown, *clypeus* brownish, *face* and *mouth-parts* dull fulvous.

Thorax brown above, with short, blackish hairs, dull fulvous beneath; *prothorax* massive, wider than head. *Legs* dull fulvous, densely clothed with short, dark brown hairs; *tibial spines* straight, black, blunt, very short compared with first tarsal joint (Plate xii, fig.3), the latter nearly as long as the other four joints put together. Between the claws is a large *empodium* or *pulvillus* (Text-fig.1), formed of a single projecting piece, cylindrical basally, bilobed distally, but on the dorsal side only; below the lobes is seen a somewhat irregular black mass, which appears to be the dried, gummy exudation from the lumen of the organ. There can be little doubt that the pulvillus is essentially an adhesive disc, which, with the aid of a sticky secretion, enables this heavy-bodied insect to walk safely on slippery surfaces, and to rest for long periods on the outside of foliage.



Text-fig.1.—Tarsal claws and empodium of *Ithone fulva*, n.sp., ($\times 30$):
a, dorsal view; b, ventral view; c, nearly profile view.

Abdomen subcylindrical, tapering slightly towards apex; in profile, segments 3-7 somewhat swollen. Colour dull fulvous. *Appendages*: *superior* strong, forcipate, 2 mm. long, pale brownish, with short hairs; *inferior* 0.8 mm. wide, rounded, dark brown, hairy (Plate xii., figs.4-6).

Wings pale semi-transparent testaceous, with a tinge of mauve towards costal border. In Plate xii, fig.1, the radius and subcosta appear to be fused, but actually R stands on a high ridge, with Sc sunk far beneath it, so that the two come into line when viewed from above. (In *I. fusca*, R and Sc are separately visible, owing to the greater breadth of the wing).

The peculiar flattened head, sessile upon the large prothorax, the crossed mandibles, short maxillary and labial palpi, and the

enlarged, contiguous procoxæ, are all shown in position, viewed from in front, in Plate xii., fig. 2.

Type in Coll. Tillyard. (♂, Stradbroke Island, September 20th, 1915).

Hab.—Stradbroke Island, S. Queensland. Two males taken on September 20th, 1915; one beaten out of a cypress-tree, another found resting on reeds in a swamp.

The following note on this species may help to throw some light on the question of whether *Ithone* is an aquatic genus or not. The town of Dunwich, on Stradbroke Island, is supplied with water from two large tanks, set high up on the side of a hill. Water is pumped from a perennial stream near the coast, about two miles distant, by means of a pipe-line, which discharges into tank A. Tank B is connected by a base-pipe, so that its level rises with that of A, but it receives no water direct from the pipe. When returning with Mr. H. Hacker, of the Queensland Museum, on September 21st, 1915, on our way to Dunwich to catch the steamer for Brisbane, we took the track up the hill to the Tanks. As the day was very hot, on arriving at the Tanks we stopped for a rest, and Mr. Hacker climbed the ladder placed between the tanks, in order to drink the cool water discharging into tank A. On looking into tank B, he noticed a large number of *Ithone* lying dead on the surface of the water, and called my attention to them. I ascended the ladder, but found that the depth of water in the tanks was so low (owing to the prolonged drought) that it was quite impossible to reach any of the *Ithone* with my net; also, they were all very much spoilt, and not worth securing as specimens. I noted, however, that they were of both sexes, and all appeared to be of a pale colour, as if newly emerged, while, in some cases, the wings were badly crumpled. In tank A, where the water was disturbed by the jet from the pipe, I did not notice any *Ithone* at all.

Now the question is, did all these *Ithone* fall into this tank and get drowned, while flying at night-time, either by pure accident, or perhaps because they are attracted by water? Or did their larvæ actually live in the still waters of tank B, and the imagines fail to escape on emerging, owing to the lack of reed-

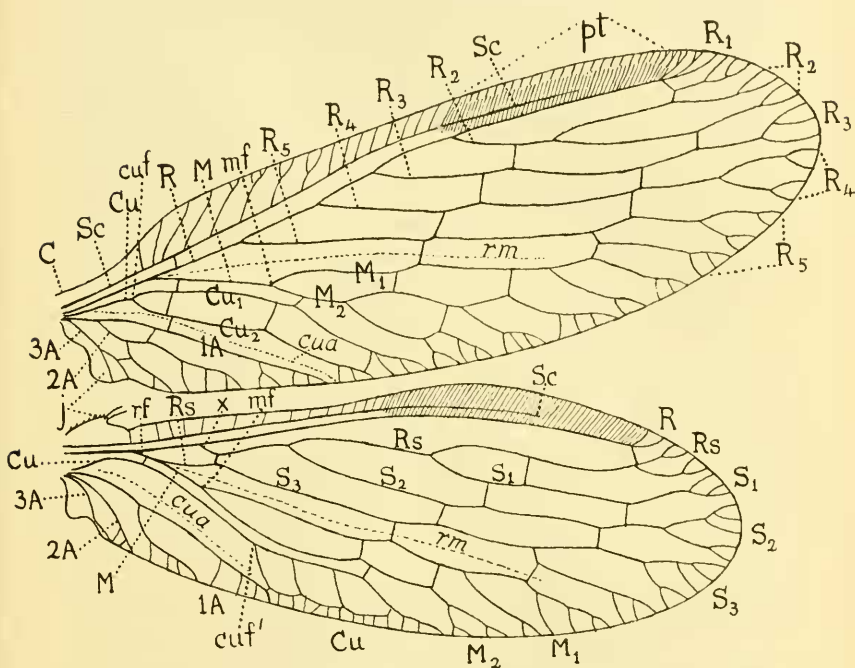
stems or other supports on which they could hang while their wings were drying?

As the pumps do not work at night, when these insects fly, I think that, if the former supposition were correct, both tanks should have contained numbers of this insect. But, of course, the strong jet of water in tank A may have drowned any insects that fell into it, and rendered them invisible. The abundance of *Ithone* in tank B (I counted over thirty), their evident immaturity, and the presence of both sexes, suggests the strong probability that the insect is aquatic in its larval stages.

Family HEMEROBIIDÆ (a me restricta).

Originally, the family *Hemerobiidae* was formed to include all those insects which had a complete metamorphosis, a larva with suctorial mouth-parts, and an imago with densely-veined wings and mandibulate mouth-parts. That is to say, the insects included in this family comprised just exactly those which now form the well-defined and almost universally admitted Order Neuroptera Planipennia. Unfortunately, the old, unscientific and out-of-date treatment of the Order continues to be used in many general works on Insects, as, for example, Sharp's "Insects" in the Cambridge Natural History, 1901(13), and Froggatt's "Australian Insects," 1907(5). The initial step forward was the recognition of the fact that the old Order Neuroptera was a composite grouping. This fact was fully accepted by both Brauer (1885) and Packard (1886), both of whom restricted the Order Neuroptera to the two families *Hemerobiidae* and *Sialidae*. The term Neuroptera Planipennia was originally used to include three families, viz., the two just mentioned, and the *Panorpidae*. With the elevation of this last family into a separate Order (Mecaptera or Panorpatae), and the *Sialidae* into a further Order Megaloptera, the Neuroptera Planipennia (or, simply, Neuroptera) was left with only those insects which went to form the old family *Hemerobiidae*. The seven subfamilies (*Myrmeleontides*, *Ascalaphides*, *Nemopterides*, *Mantispides*, *Hemerobiides*, *Chrysopides*, and *Coniopterygides*), into which Hagen (1866) originally divided the family *Hemerobiidae*, were then elevated to the rank of separate

families. Six of these families are extremely well defined, and form natural groups well marked off from one another. The seventh, the old *Hemerobiides* of Hagen, was merely a common receptacle for all the archaic remnants of the Order. It was



Text-fig. 2.—Venation of *Micromus tasmaniae* Walker, (*Hemerobiidae*).

Notation as usual; in addition, *cua*, cubito-anal furrow; *cu'f*, cubital fork; *cu'f'*, secondary ditto; *j*, jugal lobe and process; *mf*, median fork; *rf*, radial fork; *rm*, radio-medial furrow; *x*, false origin of *Rs* in hindwing.

originally subdivided into four tribes, viz., the *Dilarina*, *Nymphina*, *Osmylini*, and *Hemerobiina*. The first three of these are now generally recognised as good families. Even with the removal of these, and the elevation of the fourth tribe, *Hemerobiina*, to the rank of a family, I am still unable to find any general agreement as to what constitutes a Hemerobiid!

Thus, N. Banks, in 1909, dealing with our Australian *Hemerobiidae*(1), included both *Sisyra* and *Psychopsis* in that family. But the same author, in 1913(2), in a more general paper, includes, in the *Hemerobiidae*, four separate subfamilies, viz., *Dilarinae*, *Psychopsinae*, *Osmylinae*, and *Hemerobiinae*, without offering any diagnosis of characters common to the four. It would, indeed, be difficult to indicate any. *Sisyra* is here put into *Osmylinae*, to which it more properly belongs, but the same subfamily is made to include the whole of the *Nymphidae*, *Myiodactylus*, *Polystaechotes*, and the exceedingly archaic and isolated *Ithone*! On the other hand, Handlirsch, in 1908(6), recognised the *Sisyridae*, *Polystaechotidae*, *Dilaridae*, *Nymphidae*, and *Osmylidae* as separate families, retaining, in the *Hemerobiidae*, only three subfamilies, viz., *Berothinae*, *Psychopsinae*, and *Hemerobiinae*.

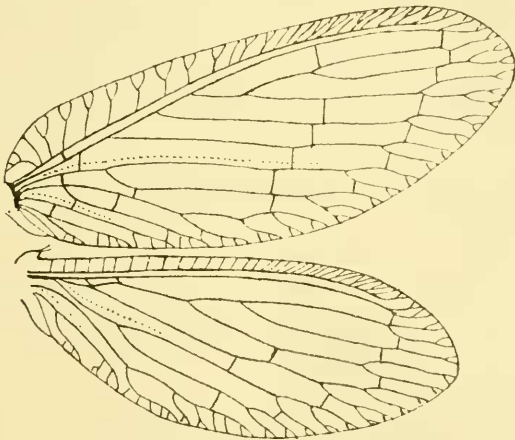
There can be little doubt that Handlirsch has most nearly achieved the task of cleansing the Augean stable, though he is certainly wrong in including *Berotha* with the *Hemerobiidae*, since it is more closely allied to the *Osmylidae*, as Banks supposed. I have already given my reasons for separating out the *Psychopsinae* as a very distinct, archaic family. What, then, are the characters by which the family *Hemerobiidae*, when reduced to its correct limits, may be known? Nowhere have I been able to find any satisfactory diagnosis—chiefly because, as we have already seen, the family has always been so cumbered with extraneous elements that a diagnosis was impossible.

I think that the family *Hemerobiidae* may be very clearly defined by the combination of the following characters (Text-figs. 2-4):—

(1). *The presence of more than one radial sector in the forewing.* This character appears to me to be of the utmost importance, since it separates out the *Hemerobiidae* at once from *all the rest of the Order*, except the *Ithonidae* and *Dilaridae*.

(2). *The absence of unspecialised cross-veins.* In the *Hemerobiidae*, the few cross-veins left are all put to some important use, either by forming gradate series (cf. *Chrysopidae*) or, in single cases, as special supports or junctions for longitudinal veins. Unspecialised cross-veins are present in the *Ithonidae* and *Dilaridae*

(3). *The presence of at least one false or secondary origin for the radial sector in the hindwing* (Text-fig.2). At least one false origin (x) is present in all *Hemerobiidæ* known to me, as well as in all *Chrysopidæ*. Owing to the true origin of Rs being placed too close to the base of the wing to afford the necessary support to the vein, the cross-vein placed next distad from it, between R and Rs, becomes strengthened and oblique, while the portion of Rs lying basad to it becomes weakened and often bent, and, in many cases, fuses basally with M. The result can be seen

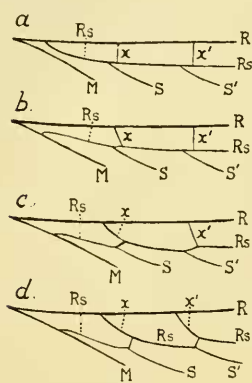


Text-fig.3.—Venation of *Hemerobius humuli* Linn.

very clearly in Text-fig.4. The false origin x (originally a simple cross-vein) appears to be the real origin of Rs, while the small portion of Rs, lying just basad to x , takes on the form of a cross-vein. In *Drepanepteryx* (Plate xiii.), a second cross-vein follows suit, and we have *two* false origins, x and x' . In *Megalomina* (Text-fig.8), we see an intermediate condition, the second cross-vein being only partly specialised, though the first has become greatly lengthened. In *Hemerobius* (Text-fig.3), two false origins are present, but are very short, owing to the close approximation of Rs to R basally.

A single false origin is always present in *Chrysopidae*, *Ithonidae*, and *Sisyridae*.

(4) *The presence, in all except very reduced forms, of a coupling apparatus at the base of the wings.* The coupling apparatus (Text-fig.2, j; also Plates xiii.-xiv, *jl*, *jp*, *fr*) consists of two parts:—



* Text-fig.4.

(a) On the forewing, a convex, projecting, oval lobe, the *jugal lobe* (*jl*), occupying the extreme base of the posterior margin.

(b) On the hindwing, a concave, projecting, and somewhat angular process, the *jugal process* (*jp*). The upturned edge of this process is fringed with fine setæ, while its apex, or angle, carries one or more very strong and stiff bristles of a larger size, constituting a true *frenulum* (*fr*) directed outwards.

During flight, the two wings on one side are coupled together by the projecting jugal process with its frenulum of bristles, which passes beneath the base of the forewing, so as to project upwards into the concavity of the jugal lobe.

These structures have frequently been remarked upon in *Drepanepteryx*, where they are, indeed, very conspicuous, and have been well figured by Sharp (13; p.468). McLachlan also described them as present in *Megalomus*, though less conspicuous. It seems extraordinary, therefore, that nobody should have noticed their presence in other genera of this family. I have examined the Palearctic genera *Borionymia*, *Hemerobius*, *Micromus*, and *Symphorobius*, and I find the coupling apparatus quite

* Diagrams to show phylogenetic development of false origins of Rs in hindwing: a, archaic stage, crossveins unspecialised (e.g., *Spermophorella*, Pl. xvii.); b, intermediate stage, first crossvein becoming oblique, Rs hitched on to M; c, false origin completed at x, second crossvein becoming oblique (e.g., *Megalomina*, Text-fig.8); d, two false origins completed at x and x' (e.g., *Drepanepteryx*, Pl. xiii.).

conspicuous in all of them. It is also present in all Australian genera; though, in extremely small and reduced forms like *Carobius* and *Notiobiella* (Plate xvi.), the jugal process is either absent or only represented by a frenulum.

That the apparatus is of very archaic origin is shown, not only by its being most highly developed in the oldest and most densely-veined forms of *Hemerobiidæ*, but also because it is present and well formed in *Ithone*, which stands very close to the ancestral stem of those insects.

(5). *The absence of any distal fusion between Sc and R.* This is the character relied upon by N. Banks. Unfortunately, in some of the most reduced genera (e.g., *Carobius*), Sc and R are so close as to be practically fused throughout their length. Also, in the *Chrysopidæ*, there is no fusion between Sc and R distally. However, from a phylogenetic point of view, the character is important, since it shows us a point in which the *Osmylidæ* and *Psychopsidæ* have undoubtedly progressed beyond the *Hemerobiidæ*. In the *Chrysopidæ*, Sc runs into the pterostigma well above R, and ends weakly there. This appears to be most certainly a specialisation from an original Hemerobiid-like condition of Sc and R. Lastly, in *Ithone*, there is the same condition of Sc as in the *Hemerobiidæ*, but Sc is deeply sunk under the high ridge of R.

(6) *The archaic, unspecialised form of Rs.* This character is shared with most other families of Neuroptera, but serves to enable us to distinguish the *Hemerobiidæ* from the *Chrysopidæ*, in which Rs is zig-zagged.

(7). *The retention of the archaic branchings of the veins as they approach the wing-border.* In the *Hemerobiidæ*, these branchings are present, and usually numerous, for all veins from the pterostigma outwards to the apex, and round along the posterior border to the base. In the costal space of the hindwing, from base to pterostigma, the cross-veins are regular and unbranched. In the forewing, however, these same cross-veins are elongated and usually branched. Only in those genera, in which the costal space of the forewing is not enlarged, do we find any considerable number of these veins unbranched.

Phylogenetically (if we may take the venation of the Mesozoic fossils as a true guide), there can be little doubt that the most archaic condition is that in which the costal space is not unduly enlarged, and the costal cross-veins either slightly, or not at all, branched, while the veins approaching all the rest of the wing-border are freely branched. Thus the costal space of the *hind-wing* retains the archaic form, while the great enlargement of the same space in the forewing, seen in such genera as *Drepanopteryx*, together with the formation of the *recurrent costal veinlet* (Plate xiii., Cr) must be regarded as specialisations correlated with increase in wing-breadth.

(8). *The fusion of M with R basally in the forewing, and the fusion of M in the hindwing with the weakly formed, original, basal portion of Rs.* These are distinct specialisations in the venation, which, though found in the *Chrysopidae* and *Dilaridae* also, offer a definite distinction from the *Ithonidae* and *Osmylidae*, where M is fused with R in both wings.

(9). *The unspecialised form of the antennæ.* These are formed of very numerous, small joints, the basal joint being usually slightly enlarged. The antennæ may be described as slender, moniliform, and very finely pectinate. In length, they vary from a little less than half the wing-length (*Drepanopteryx*), to about the full length of the wing (*Oxybiella*). They most closely resemble the antennæ of *Osmylidae* (probably the most archaic form of these organs), but these latter have the separate joints longer and thinner by comparison. The antennæ also serve to distinguish the *Hemerobiidae* from the *Psychopsidae*, in which these organs are exceedingly short; from the *Chrysopidae*, in which they are exceedingly long; and from the *Nymphidae*, in which they are distinctly thickened.

(10). *Position of rest:* the wings completely hiding the body, and placed almost vertically to the resting-plane, with the costal margins downwards, the posterior margins meeting in a high ridge above the body; the head bent downwards, and often partly hidden by the projecting costæ of the forewings.

This resting-position is very like that of the *Osmylidae*, and *Coniopterygidae*, in both of which, however, the head shows much

more freely in front of the wings, while the approximation of the two pairs of wings towards the mid-vertical plane is not so great. The *Psychopsidæ* rest quite differently, with the wings forming a very flat roof over the body, the angle between each forewing and the resting-plane being very small. The resting position of *Ithone* resembles that of a Hepialid moth.

Having thus indicated the principal characters of this (as it seems to me) exceedingly clearly defined family, we may summarise them in the following short definition. *Small, short-bodied insects with short prothorax. Antennæ of moderate length, moniliform, finely pectinate. Ocelli absent. Wings held almost vertically in repose, with costal margins downwards, completely hiding the body. Generalised form of Rs (not zig-zagged), and numerous branchings of the veins at the margins of the wings. Sc and R not fused distally. M fused basally with R in forewing, with weak base of Rs in hindwing. At least two radial sectors in forewing; only one in hindwing, but this one strengthened by the development of at least one false origin, formed from a cross-vein placed distad from the true origin. Absence of all unspecialised cross-reins; the few that are present forming either gradate series or special braces between the main veins. A coupling apparatus, in the form of jugal lobe and process, nearly always present at base of wings.*

The *Hemerobiidæ*, then, are distinguished from the other families with which they are likely to be confused, as follows (the characters are numbered as above):—

From all except the *Ithonidæ* and *Dilaridæ*, by (1): from the *Ithonidæ* and *Dilaridæ* by (2). In particular

From the *Psychopsidæ* by (1), (3), (4), (5), (9), and (10).

From the *Osmylidæ* by (1), (2), (3), (4), (5), (8), and (9), as well as by the peculiar, elongated and upcurved mandibles of the *Osmylid* larvæ.

From the *Chrysopidæ* by (1), (4), (6), (7), (9), and (10).

From the *Sisyridæ* by (1), (5), and the important differences in larval form and life-history.

From the *Berothidæ* by (1), (3), (4), and (5), and the absence of any scales on the wings of the female.

The genera *Rapisma* and *Oliarces*, included in the *Hemerobiidae* by N. Banks(2), must be removed from that family as defined above, on account of the presence of only one radial sector, and numerous, unspecialised cross-veins. I think that a new family will be required for these two genera. They are not found in Australia.

I have not attempted to divide the *Hemerobiidae* into sub-families, because it seems to me that a single phyletic line of descent is clearly indicated, with all the intermediate stages still present, from the comparatively large, densely-veined, and most generalised form (*Drepanepteryx*) right down to the smallest forms (*Symphorobius*, *Notiobiella*, etc.) in which the venation is comparatively simple, and in which all the signs of a high specialisation by reduction are evident. Thus, if we attempt to separate *Drepanepteryx* and its allies off on a very important venational character (as I had hoped to do), viz., the presence of the original Cu_2 in the hindwing, we shall make an unnatural grouping; for a new genus (*Drepanomina*) has just come to light, which is most certainly a close ally of *Drepanepteryx*, but lacks this important vein. Nor does the falcate form of wing justify us in elevating this same group into a subfamily, since, in other respects, *Drepanomina*, *Megalomus*, and *Megalomina* are very closely allied. Again, while we can pass in a descending scale (by reduction) from *Drepanepteryx* to *Drepanacra*, thence to *Drepanomina*, and thence directly to the pointed-winged forms *Megalomina* and *Oxybiella*, the connection with the smaller, round-winged forms is supplied by *Micromus*, which is clearly a specialisation from *Megalomina* (loss of recurrent costal vein by narrowing of costa), and in a somewhat different direction by *Psychobiella* (fusion of the two basal radial sectors of forewing into one). Thus we arrive, at last, at a form with only three radial sectors in the forewing. The final reduction to two radial sectors is actually accomplished, in the Palearctic region, within the range of the type-genus *Hemerobius* itself; while, in Australia, the line of reduction passes on from *Psychobiella* to *Notiobiella*, with *Carobius* as a side-branch.

In the actual practice of determining genera of *Hemerobiidae*

from tables or keys based upon venation, it seems to me that much confusion would be avoided (especially for those whose knowledge of the group is not extensive) if two points were carefully borne in mind. Firstly, it is necessary to be able to pick up the median vein at a glance. But, owing to the basal fusion of this vein with R or Rs, how can we recognise it with certainty, except by recourse to the pupal tracheation? This can always be done by looking for the *radio-median furrow* (Text-fig.2, *rm*), a deep groove which separates the last (most basal) branch of R in the forewing, or Rs in the hindwing, from M. This furrow runs just anteriorly to M, and, in certain lights, it shows up as a white, shining line, even more conspicuous than the veins themselves. The median vein also is always two-branched in *Hemerobiidae*, the fork being called the *median fork* (Text-fig.2, *mf*). In the Plates, *rm* is represented as a dotted line. A similar, very distinct furrow separates Cu from A, and is designated the *cubito-anal furrow* (Text-fig.2, *cua*). Occasionally, as in *Drepanepteryx* (Plate xii., fig.1), a third furrow, the *medio-cubital*, separates M from Cu, but usually this is absent.

Secondly, it must be remembered that the cubitus of the hindwing in *Hemerobiidae* is a highly specialised vein. In most genera, it forms a high ridge, and is much stronger and thicker than any vein near it. Now the sharp forking of this ridge, which can often be seen at a level distad from that of *mf*, is *not* the *primary fork* (*cuf*) dividing Cu into Cu₁ and Cu₂, but the *secondary fork* (*cuf'*) dividing Cu₁ into Cu_{1a} and Cu_{1b}.^{*} This can be seen at once by referring to *Drepanepteryx* or *Drepanacra* (Plate xiii.), where *cuf* may be seen very close to the base of the wing, with Cu₂ as a weak vein running parallel and close up to Cu₁. How Cu₂ has been lost, can be clearly seen in *Drepanomina* (Plate xiv., fig.18), where the cubito-anal furrow is double,

^{*} The resemblance of this secondary fork to the cubital fork in *Myrmeleontidae* has led me to re-examine the structure of the cubitus in this latter family. As a result, I have discovered, in the *Dendroleontine* and *Acanthaclisis*, the remnant of the true Cu₂ near the base of the forewing. It follows that the branch hitherto called Cu₂ is in reality Cu_{1b} for the forewing, and probably for the hindwing also.

the anterior portion representing the just-vanished vein, the posterior the true furrow.

If these points be kept in mind, there should be no difficulty in determining all the Australian genera from the key here offered. As most of the Australian forms are exceedingly rare in collections, I have figured every known genus, in the hope that our Lepidopterists and Coleopterists, even if they cannot be expected to master the intricate venation of the wings, may recognise their captures from the figures, and save them for the advancement of the study of this interesting family, of which Australia may yet be proved to possess a large number of representatives.

Key to the Australian Genera of the Family *Hemerobiidæ*.*

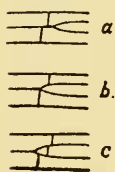
- | | | | |
|----|---|---|----|
| 1. | { | Forewing distinctly falcate at tip, the margin of the wing being distinctly excavated posteriorly to the apex (<i>Drepanopteryx</i> -group)..... | 1. |
| | | Forewing either rounded or pointed at apex, but not falcate. (<i>Hemerobius</i> -group)..... | 2. |
| 1. | { | Costal area of forewing broad at base, narrowing gradually and regularly towards pterostigma. Cu_2 present in hindwing..... | 3. |
| | | Costal area of forewing narrow at base, then swelling out into a kind of hump, and finally becoming very narrow again towards pterostigma. Cu_2 absent in hindwing, its position occupied by a furrow..... <i>Drepanomina</i> , n.g. (Type <i>D. gibbosa</i> , n.sp.). | |
| 2. | { | Forewing distinctly pointed at apex..... | 4. |
| | | Forewing rounded at apex..... | 5. |
| 3. | { | Forewing with numerous (ten or more) radial sectors, and with M_1 and M_2 both branched again close to <i>mf</i> . Hindwing with Cu_2 not united to Cu_{1b} distally. Three complete gradate series in forewing, two in hindwing.....
..... <i>Drepanopteryx</i> Burm., (Palearctic). (Type <i>D. phalenoides</i> L.). | |
| | | Forewing with fewer (four to six) radial sectors, and with no secondary branchings of M_1 and M_2 . Hindwing with Cu_2 and Cu_{1b} united distally. Only two complete gradate series in forewing; hindwing with outer gradate series complete, inner series represented by a few cross-veins.....
..... <i>Drepanacra</i> , n.g. (Type <i>D. humilis</i> McLach.). | |

* The Palearctic genus *Drepanopteryx* is included, in order to show the differences between it and the Australian species, which have hitherto been included in it.

wing, which can be seen in Newman's type. All the species are, however, so exceedingly variable in ground-colour and markings, that it seems almost certain that Newman's type was an extraordinary variation, which may not turn up again for a very long time. As *D. humilis* McLach., is, at the same time, the commonest and the least variable species, it seems wise to fix this species as the type of the new genus *Drepanacra*.

In this genus, variability is not confined to the colouration, but extends also, within certain limits, to the venation of the wings, while the limits of size for any given species are also considerable. The task of working out the material which has passed through my hands has been a very laborious one; though, indeed, it would prove delightful enough to the confirmed "splitter," who could describe new species to his heart's content, on the extraordinary variations of colour-scheme. A peculiar difficulty is met with in this and many other Hemerobiid genera, viz., that, after death, the body, inconspicuous enough even in life, shrivels up so completely that it is quite useless for specific diagnosis. As for the colour of the antennæ, this varies with age, being palest in freshly emerged specimens. We must have recourse, then, almost entirely to the wings for our specific characters. Even here, we must proceed with great caution, and define our species so as to take account of the extremes of venational variation.

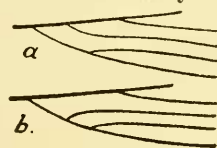
Two characters that are of the greatest importance generally in the *Hemerobiidæ*, and that have been used for defining species in *Drepanacra* by McLachlan, are found to be variable when any large number of specimens is examined. These are (1) the number of cross-veins in the gradate series, (2) the number of radial sectors in the forewing. In order to explain the reason for the variability in these characters, reference should be made to Text-figs.5 and 6. As regards the outer gradate



* Text-fig.5. Diagrams to show inconstancy of number of crossveins in the outer gradate series of *Drepanopteryx*: a, usual condition; b, approach of a fork to gradate series; c, interpolation of an extra crossvein in the gradate series.

series (Text-fig.5), we see that a distal forking of one of the sectors may become interposed between two of the gradate veins, and thus allow of the occasional introduction of an extra cross-vein. I propose, therefore, to lay down two rules for numbering these cross-veins:—(1) only to count cross-veins from the most anterior branch of Cu_1 upwards; (2) to give, as the *normal* number, the number counted in specimens in which no extra cross-vein is interposed in the manner shown in Text-fig.5, c.

Secondly, as regards the number of radial sectors in the forewing. In all specimens of *Drepanacra* which I have examined, the most distal branch of R, viz., R_2 , gives off one or more *posterior* branches, while the most basal branch gives off one or more *anterior* branches. The branching of the former is nearly constant, there being only *two* posterior branches (small forkings distad from the outer gradate series are not taken into account). But, for the most basal branch, we find two conditions almost equally prevalent. Either this branch gives off only a single, anterior branch, and is followed distally along R by a *fixed number* of simple sectors; or else it gives off *two* anterior branches, and is followed by *one less than this fixed number* of simple sectors. The explanation of this is, that what is really the second sector from the base frequently becomes detached from R, and fuses on to the most basal sector, giving it an extra branch anteriorly. This is shown in Text-fig.6. A single specimen sometimes has the condition *a* on one side, and the condition *b*



* Text-fig.6.

on the other. To deal with this variability, I propose the following plan. An imaginary line, drawn approximately parallel to and just inside the outer gradate series, will cut all the radial sectors and their main branches. If we denote a single sector by the figure 1, a sector with one branch by 2, and so on, and reckon from the distal (anterior) end of our imaginary line

* Variation in condition of branches of radius in forewing of *Drepanopteryx*: *a*, archaic condition; *b*, the second branch from the base becomes hitched on to the most basal branch.

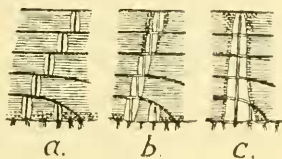
downwards to M_1 , we obtain what I shall call the *radial formula*, which may be equated to the total number of branches passed. Thus for *D. humilis*, as figured in Plate xiii., fig.2, we have

Radial formula, $3 + 1 + 1 + 1 + 2 = 8$ (the count stopping short at the vein lying above the radio-median furrow, shown as a dotted line). An equally common, radial formula for this species is $3 + 1 + 1 + 3 = 8$, representing the case shown in Text-fig.6, *b*.

One of the most remarkable structures to be seen in the wing of *Drepanepteryx phalænoïdes* is the peculiar transparent patch, at about the middle of the posterior border of the forewing, resembling a split or tear in the wing. Such a structure I propose to call a *fenestella* (Lat. = a little opening). It occurs in a slightly less conspicuous form in some species of *Drepanacra*. Its effect is to give the insect, when at rest, the appearance of a dead leaf, with a small tear in it. It is clearly a development correlated with the falcate type of wing, for the effect of a dead leaf is obtained primarily by this latter formation, and there is no record of a fenestella occurring in any but a falcate wing. This is a nice little problem in protective resemblance, which has long puzzled entomologists.

If we examine a fenestella (Plate xiii., figs.11, 13), we shall see that the apparent interruption of the veins is a very simple deception brought about by the absence of pigment. The veins are all present, and are all easily seen under a moderate power of the lens, the actual condition being such as I have shown in my drawings, and not as figured by Sharp (13; p.468). The "split" effect is obtained (1) by the complete absence of pigment on the wing-membrane within the fenestella itself, and (2) by a certain amount of increase of the pigment surrounding it. To understand how the fenestella arose, we must first of all realise that it is formed around a small series of cross-veins which have been brought into line; they are, in fact, a posterior extension of the outer gradate series, originally, no doubt, arranged in step-form, but later on combined to form a single line running transversely in from the wing-border. Now we have many cases of the enclosure of gradate cross-veins in small pigmentless areas,

in an otherwise pigmented wing. For instance, in *Psychopsis illidgei*, the whole of the outer gradate series runs through a deeply pigmented brown mark on the wing; but each separate cross-vein is enclosed in a tiny clear area of the kind shown in Text-fig. 7, *a*. If we admit that the fusion of our cross-veins, in the case of *Drepanopteryx*, took place originally as a specialisation for mechanical advantage, and that, at the same time, these cross-veins happened to be enclosed in small, clear areas as they are in *Psychopsis illidgei*, we get at once a weak fenestella of the form seen in *D. humilis*. A slight extension of this gives us the well-formed fenestella of *D. phalaenoides*. Thus it would seem that the formation of this peculiar structure may well be due to the accumulation of small, advantageous variations to the benefit of the species, and that it is really an excellent illustration of the action of "natural selection" in the strict, Darwinian sense.



* Text-fig. 7.

In *Drepanacra*, the forewing is considerably less falcate than it is in *Drepanopteryx*. It is interesting, therefore, to find in this genus the development of still another structure of the same nature as the fenestella, viz., a set of one or more, white (unpigmented) *lunules* along the falcate border of the wing. One of these lunules is shown in Plate xiii., fig. 14, enlarged, while the set of three, usually present in *D. humilis*, is shown in fig. 12 of the same Plate. These structures not only serve to increase the *apparent falcation* of the wing, but, when well developed, they suggest a series of small "bites" or "tears" out of the edge of the dead leaf, which the wing so closely represents in repose, and thus contribute, presumably, to the immunity from attack enjoyed by these archaic insects.

As regards the *frenulum* of *Drepanacra* (Plate xiv., fig. 19), it is of a more specialised form than that figured by Sharp (13; p. 468) for *Drepanopteryx*. I find, in the males of *D. humilis*, that the

* Diagrams to show the evolution of a fenestella: *a*, gradate crossveins in small, clear areas; *b*, alignment of same; *c*, fenestella completed.

frenulum consists of a single, strong bristle, usually blackish; while, in the females, there are two, somewhat shorter and paler bristles, one longer than the other. In *D. instabilis*, it is probable that the same condition holds, but I have seen only three females of this species. Thus it would seem that the form of the frenulum is of no help in specific diagnosis, but that it enables us to distinguish the sexes, when, as is usually the case, the abdomen is too shrivelled for that purpose. The average expanse of the females is about 1 mm. greater than that of the males, for any given species.

The following key will separate the five known species:—

- | | | | | |
|----|---|---|---------------------------------|----|
| | { | Forewing with a conspicuous, nearly round, dark spot, encircled by a pale ring, situated near the posterior angle.
Expanse 15 mm..... | <i>D. binocula</i> (Newman). | |
| | | Forewing with no such spot..... | | 1. |
| 1. | { | Small species, expanse 15-16 mm., without any definite fenestella, radial formula $3 + 1 + 1 + 2 = 7$, rarely $4 + 1 + 1 + 2 = 8$. | | 2. |
| | | Larger species, expanse 16-22 mm., fenestella present; radial formula totalling 8 or 9..... | | 3. |
| 2. | { | Tip of forewing barely falcate; deep mottled grey-brown colouration on forewings..... | <i>D. hardyi</i> , n.sp. | |
| | | Tip of forewing distinctly falcate; forewings pale, with irregular, brownish markings..... | <i>D. froggatti</i> , n.sp. | |
| 3. | { | Ground-colour of forewing uniform ochreous or medium brown, without numerous irregular markings, and with little or no sign of numerous, oblique fasciae extending inwards from costa. Forewing slightly falcate, with moderately rounded tip. Usually three lunules. Radial formula nearly always totalling 8. Hindwing with 5-6 branches of Rs. Expanse 16-18 mm..... | <i>D. humilis</i> (McLach.). | |
| | | Forewing much more irregularly marked, with numerous, distinct, oblique fasciae extending inwards from costa; very distinctly falcate, with pointed tip. Radial formula totalling 8 or 9. Hindwing with 6-7 branches of Rs. Expanse 19-22 mm..... | <i>D. instabilis</i> (McLach.). | |

3. *DREPANACRA HUMILIS* McLachlan. (Plate xiii., figs. 12-14).

McLachlan, Journ. Ent., Nov. 1863, pp. 111-116.

The venation figured in Plate xiii., fig. 12, is that of a female, expanse 18 mm. The following seem to be the most important

characters. *Radial formula* usually either $3 + 1 + 1 + 1 + 2 = 8$ (as in figure) or $3 + 1 + 1 + 3 = 8$ (as in specimen figured by Esben-Petersen, These Proceedings, 1914, xxxix., Pl. lxxiv., fig. 8); very rarely $2 + 1 + 1 + 1 + 1 + 2 = 8$. *Hindwing* with 5-6 branches of Rs, usually 5, the two false origins of Rs well-formed but short; very little cloudiness on hindwing, usually only along costa and proximal part of posterior margin to Cu_{1b} , and a cloud on Cu_{1b} itself. *Fenestella* usually fairly distinct, sometimes not very clear. *Lunules* distinct, three in number, very rarely four. *Number of gradate cross-veins* above Cu_1 , in forewing, 9-10 in inner, 11-13 in outer series; in hindwing, 4 in inner, 10-11 in outer.

As regards Australian specimens, it may be given as a general rule that the most northern forms are the smallest and palest, the most southern forms the largest and darkest. McLachlan's type, from Moreton Bay, is smaller than any specimen I have examined. The specimen from Melbourne, examined by Mr. Petersen, and determined as conspecific with McLachlan's type, has an expanse of quite 18 mm.; while the expanse of the type-specimen is given as "7 lines," *i.e.*, just over 14 mm., which is considerably smaller than any specimen of *Drepanaera* known to me. I think, however, that the printed measurement is an error, since the body-length is given as "3 lines," and the very carefully drawn figure shows the expanse to be quite thrice the body-length.

The following varieties, or forms, may be distinguished.

a.—The type-form; ground-colour of forewings greyish-ochreous, subhyaline, with a few, scattered, black dots; hindwing with ochreous pterostigma.

This form is typical of S. Queensland and New South Wales; Victorian specimens are, on the whole, slightly darker and more distinctly marked, usually with a distinct row of black spots along the inner gradate series. One Victorian specimen in Mr. Froggatt's collection has the forewings a rich brown, the hindwing shaded with brown.

Localities.—Brisbane district, S. Queensland; Sydney district, N.S.W., common (including two specimens bred from larvæ found in rolled-up leaves of *Eucalyptus* saplings, feeding upon the common Sugar-lerp, *Psylla eucalypti*, at Hornsby); National Park, N.S.W., fairly common; Melbourne, Victoria; Mt. Wellington, Tasmania.

b.—Var. *tasmanica*; ground-colour of forewings rich russet-brown; hindwing with reddish pterostigma. The usual form taken in Tasmania; Hobart; Maria Island.

c.—Var. *longitudinalis*; a dark, longitudinal streak runs from base to apex of forewing.

National Park, one specimen, November 20th, 1915; Maria Island, Tasmania, one specimen, December 31st, 1915, taken by Mr. G. H. Hardy. This latter has the ground-colour of var. *b*. The National Park specimen has a radial formula,

$$2 + 1 + 1 + 1 + 1 + 2 = 8.$$

4. DREPANACRA INSTABILIS McLachlan. (Plate xiv., fig.15).

McLachlan, Journ. Ent., Nov. 1863, pp.111-6.

The venation figured is that of a female, expanse 21 mm.

Radial formula $3 + 1 + 1 + 1 + 3 = 9$, or $4 + 1 + 1 + 3 = 9$, or $3 + 1 + 1 + 4 = 9$. Very rarely, $3 + 1 + 1 + 1 + 2 = 8$. *Hindwing* with 6-7 branches of Rs, usually 6; the two false origins of Rs are longer than in *D. humilis*; cloudiness usually much more marked than in *D. humilis*. *Fenestella* usually quite distinct, and placed more perpendicularly to the wing-margin than in *D. humilis*. *Lucules* very distinct, usually four, rarely three or five. *Number of gradate cross-veins* above Cu_1 , in forewing, 10-11 in inner, 12-14 in outer series; in hindwing, 4-5 in inner, 10-12 in outer.

Differs from *D. humilis* in its larger size, stouter thorax, more falcate wing-tips, slightly denser venation, and generally much more varied colouration.

McLachlan's type was described from New Zealand; his figure shows a beautifully variegated form. The three specimens which

I have seen, and which I refer to this species, are of very different appearance from one another, as follows:—

a.—A beautifully variegated specimen from Brisbane, not unlike the type in markings.

b.—Var. *pallida*. An almost colourless, transparent specimen from Hobart, Tasmania, taken by Mr. C. Cole, December 16th, 1915, and forwarded by Mr. G. H. Hardy. The lunules and fenestella are deeply bordered with blackish. There is also a black patch near the base of the hindmargin of the forewing, and some dark specks along Sc + R. Radial formula is $3 + 1 + 1 + 3 = 8$ on one side, $3 + 1 + 1 + 1 + 2 = 8$ on the other.

c.—Var. *rubrinereis*. A richly marked specimen from Maria Island, Tasmania, taken by Mr. G. H. Hardy, April 3rd, 1915. Ground-colour of forewing rich brown, with a patch of russet on costa; many of the veins crimson; numerous darker irrorations all over the wing, and several oblique fasciæ extending into the wing from the costa; hindwing clouded all round the margin and along Cu_{1b} .

5. DREPANACRA BINOCULA Newman.

Ent. Mag., v., 1838, p.400. See also McLachlan, *loc. cit.*

The expanse is given as “·6 unc” = about 15 mm. As I have already stated above, I think that this type will prove to be an exceptional variety of one of our commoner species, in which case the name now in use must sink as a synonym of *binocula* Newm. I know of no specimens of *Drepanacra* with a conspicuous eye-spot on the wings. The type is in the British Museum, so that it may be possible to get a detailed description of the form and venation of the wings later on.

6. DREPANACRA HARDYI, n.sp. (Plate xiv., fig.16).

A single specimen taken by Mr. C. Cole at Hobart, Tasmania, on December 18th, 1915, and forwarded by Mr. G. H. Hardy, is so distinct from all other specimens seen by me, that I have no hesitation in naming it as new to science. Expanse 15·5 mm.

Radial formula $3 + 1 + 1 + 2 = 7$ on left side, $4 + 1 + 1 + 2 = 8$ on right side. Forewing broad, scarcely falcate, deep grey,

spotted and marked all over with darker grey-brown, hindwing much clouded. Cross-veins of the outer gradate series in both wings strongly marked with black. *Hindwing* with six branches to Rs. *Fenestella* absent. *Lunules* of forewing coalesced into a single, long lunule. *Number of gradate cross-veins* above Cu_1 , in forewing, 9 in inner, 11 in outer series; in hindwing, 3 in inner, 10 in outer series.

Type in Coll. Tillyard. Unique.

Easily distinguished by its small size, broad and scarcely falcate forewings, dark grey-brown colouration, absence of fenestella, and fusion of lunules.

7. DREPANACRA FROGGATTI, n.sp. (Plate xiv., fig.17).

A small specimen, expanse 15.5 mm., in Mr. Froggatt's collection. Resembles *D. hardyi* in size and venation, and in the absence of fenestella; differs from it in possessing a much more falcate forewing, and a totally different colouration, this latter being variegated as in the type-form of *D. instabilis* McLach., but duller. Ground-colour of forewing pale greyish-ochreous, semi-hyaline; an irregular, dull brownish cloud behind the lunules, which are separate, four in number, but not very distinct; a slight brown cloud around the median fork, and five or six, faint, oblique, brown fasciæ running into the wing from the costa. About five of the cross-veins of the outer gradate series, situated behind the lunule, marked with black. Hindwing marked with greyish-brown on pterostigma, along base of hind-margin, along whole of outer gradate series, and on Cu_{1b} .

Type in Coll. Froggatt. Unique. Not labelled, but Mr. Froggatt tells me that it was taken in Victoria. It resembles a very dwarfed *D. instabilis*.

Genus DREPANOMINA, n.g. (Plate xiv., fig.18).

Characters as given above in the table.

A very distinct genus, easily recognised by the costal hump on the forewings, the extreme falcation of both fore- and hindwings, and the absence of Cu_2 in the hindwing.

Genotype, *D. gibbosa*, n.sp.

Apart from the peculiar shape of the wings, the venation shows this genus to be closely allied to *Megalomina* Banks, with which it agrees in the number and form of the gradate veins, there being three in the forewing and two in the hindwing, though the middle series of the forewing and the inner of the hindwing are more complete than in *Megalomina*.

8. *DREPANOMINA GIBBOSA*, n.sp. (Plate xiv., fig. 18).

Total length 7 mm., forewing 10 mm., expanse 21.5 mm.

Head brown, heavily marked with shining black on epicranium and face; eyes dark brown; antennae pale brown at base, the rest ochreous, annulated with dark brown. Thorax: *prothorax* blackish, with a rich orange-brown median patch on notum; rest of thorax blackish, with a paler brown border posteriorly on metathorax. Abdomen (shrunken) brownish; markings indistinct. Wings: *forewings* with all veins alternately speckled with dull whitish and dark brown, the general effect being a medium brown colour all over the wing; posterior margin from apex nearly to base marked with dark brown in regular patches, isolating paler areas suggestive of the lunules of *Drepanocera*; a darker brown cloud runs obliquely across the wing not far from the falcate border, and is widest on the posterior margin, and tapering almost to a point towards the costa, not far from the apex; a number of short, dark, oblique streaks on R, and just proximally to the brown cloud. *Hindwings* with venation around the margins, and in distal half of wing, dull brown; in basal half of wing, whitish; pterostigma pale straw-colour. No fenestella.

Radial formula $2 + 1 + 1 + 1 + 1 = 6$. *Hindwing* with five branches to Rs; only one false origin, but that very strongly developed, Rs being strongly looped concavely to R, and strongly bent at origin of its most basal branch.

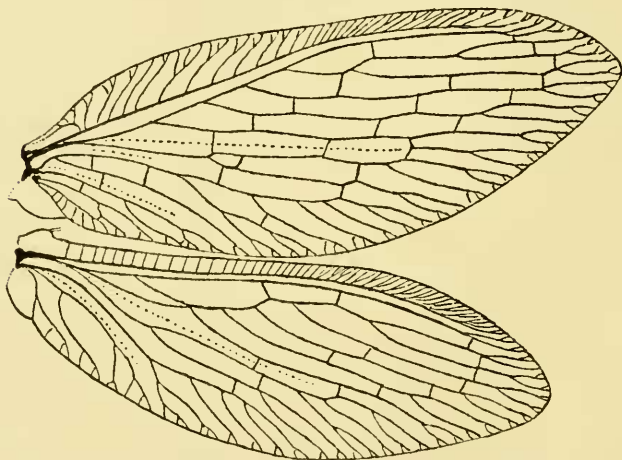
Type in Coll. Froggatt. Unique. Not labelled; but Mr. Froggatt informs me that it was taken in Victoria.

Genus MEGALOMINA Banks. (Text-fig.8).

Banks, Proc. Ent. Soc. Washington, xi., 1909, p.78.

Wings rather broad, lanceolate. *Forewing* with four radial sectors, all simple except the most distal one, which has two posterior branches; three series of gradate cross-veins; costal space narrow at extreme base, and then broadening considerably; recurrent costal veinlet present, but not conspicuously branched. *Hindwing* with no true Cu_2 ; Cu_1 strongly formed, sharply branched at *cuf*': Rs with one false origin, very oblique and elongated, and a second cross-vein slightly oblique; between the two, Rs is curved concavely to R, and gives off several branches; five branches to Rs altogether; two gradate series.

Genotype, *M. acuminata* Banks.



Text-fig.8.—Wings of *Megalominia acuminata* Banks.

9. MEGALOMINA ACUMINATA Banks. (Text-fig.8).

Banks(1; p.78). Esben Petersen(11: p.642, and Pl. lxxiv., fig.9).

This species appears to be very rare. Banks' type came from Bundaberg, Q. A second specimen is in Mr. Froggatt's collection (loc. Queensland), and is the one figured by Petersen. The specimen, whose venation is figured in Text-fig.8, was taken by me at One-Tree Hill, Brisbane, on September 23rd, 1915, by

sweeping the lower branches of a Hoop-Pine (*Araucaria Cunninghamii*) with a large net.

This is the only species of the genus.

Genus OXYBIELLA, n.g. (Plate xv., fig.20).

Antennae nearly as long as forewing. *Wings* narrow lanceolate, very sharply pointed. *Forewing* with four radial sectors, all simple except the most distal; inner gradate series present, and arranged close under, and nearly parallel to R; outer series not regularly formed; no middle series; costal space very narrow at base, then somewhat broadened; recurrent costal veinlet present, but very weakly formed. *Hindwing* with no true Cu_2 ; Cu_{1b} rather weak and curved; a single rather long and oblique false origin to Rs; Rs with four branches; jugal process very prominent. *Hind tibiae* broadened, blade-like.

G e n o t y p e, *O. bridwelli*, n.sp.

This genus is most closely allied to *Megalomina*, from which it differs by the narrower and more pointed wings, and the absence of the middle gradate series in the forewing.

10. OXYBIELLA BRIDWELLI, n.sp. (Plate xv., fig.20).

Total length 4.8, *antennae* 5.5, *forewing* 8, *expanse* 17.5 mm.

Head pale brownish; *eyes* black; *antennae* long and slender, basal joint swollen, pale yellowish-brown, rest brownish with darker annulations. *Thorax*: *prothorax* large, divided into three by two fine transverse furrows, brownish. *Pterothorax* broad, brownish. *Legs*: femora brown, tibiae testaceous, just touched with rose-pink, tarsi testaceous with black claws. *Abdomen* dark brown, apex rounded; no visible appendages. *Wings*: *forewing* semi-transparent brown, with a clear whitish streak running longitudinally through distal three-fifths of wing to tip, a less distinct and more irregular white streak below it in region between M_1 and Cu_1 ; also a subtriangular whitish area between Cu_2 and 1A. All these white areas bordered irregularly with black blotches; a number of smaller black spots along R. Venation of forewing brownish, except branches of R and M, which are rose-coloured. *Hindwing* hyaline, shaded with brown lightly on costa, pterostigma, and hindmargin.

Type in Coll. Tillyard. Unique.

This very striking insect was taken by Mr. J. C. Bridwell, of Honolulu, on September 12th, 1915, while collecting with me at Kedron Brook, Brisbane. It was beaten out of a small wattle-tree whose foliage was completely covered, and almost destroyed, by a small species of Psyllid.

Genus *PSYCHOBIELLA* Banks. (Plate xv., fig.21).

Banks (1; p.79).

Antennae quite two-thirds as long as forewings. *Wings* well rounded at tips. *Forewing* with three radial sectors, two arising close together near middle of R, and the third close to the base, just distad from M; this last gives off an anterior branch, strongly arched upwards; the middle sector is simple, the most distal sector many-branched. Costal space of forewing broad near base, the recurrent veinlet present, with a number of forked branches. Two gradate series in both wings, the outer very long and running nearly parallel with the wing-margin, the inner with much fewer cross-veins. *Hindwing* with two well-developed false origins to Rs; Cu₂ absent, Cu_{1b} fairly well formed, but not diverging strongly from Cu_{1a} at *cu1''*.

Genotype, *Ps. sordida* Banks.

The genus is a very distinct one, but may be considered as a rather specialised derivative from *Megalomina*, in which the number of radial sectors in the forewing is reduced from four to three, by the shifting of the origin of the second sector from the base on to the stem of the most basal one. This gives, as a fixed generic condition, the arrangement which occurs as a frequent variation in *Drepanocera*, as shown in Text-fig.6, *b*.

There are two closely allied species, which may be distinguished as follows:—

Forewings brown, with reddish stigma; hindwings with three branches to Rs; middle tibiae fusiform	<i>Ps. sordida</i> Banks.
Forewings fuscous, stigma dull brown; hindwings with five branches to Rs; all the tibiae slightly fusiform, those of hind-legs elongated and somewhat flattened	<i>Ps. fusca</i> , n.sp.

11. *PSYCHOBIELLA FUSCA*, n.sp. (Plate xv., fig.21).

Total length 4·7, *forewing* 8·5, *expanse* 18 mm.

Head: *eyes* dull black; *antennæ* brown with darker annulations, basal joint semitransparent orange-brown, enlarged; *epicranium* hairy, brown; *face* yellowish-brown. *Thorax* and *Abdomen* dark brown. *Legs*: forelegs dark brown; the rest pale testaceous. *Wings*: *forewings* deep semitransparent fuscous, tinged with blackish along basal half of hind-border; pterostigma dull brown, with a fine yellow line passing through it just below costal margin. *Hindwing* hyaline, with brownish stigma.

Type in Coll. Tillyard. A unique specimen, captured by me at One-Tree Hill, Brisbane, on September 23rd, 1915, while sweeping the branches of the same pine-tree from which I obtained *Megalomina acuminata*.

Genus *MICROMUS* Rambur. (Text-fig.2).

Rambur, Hist. Nat. Névroptères, 1842.

Wings rounded at tips. *Forewing* with four or more radial sectors, regularly and evenly spaced off from one another, all simple except the most distal. Two series of gradate cross-veins in both wings. *Hindwing* with only one false origin to Rs; Cu₂ absent, Cu₁ close to M, Cu_{1b} weakly formed. *Pterostigma* strongly formed, especially in hindwing.

Genotype, *M. variegatus* Fabr.

The two Australian species of this widely distributed genus may be separated as follows:—

- | | | |
|---|---|------------------------------------|
| { | Smaller species, with only five radial sectors in forewing..... | <i>M. tasmanic</i> (Walker). |
| | Larger species, with broader wings and six radial sectors..... | <i>M. vinaceus</i> Gerst. |

12. *MICROMUS TASMANIC**(Walker). (Text-fig.2).

Walker, "Characters of undescribed Neuroptera in the Collection of W. W. Saunders, Esq.," Trans. Ent. Soc., v., 1859. = *M. australis* Froggatt, Agricultural Gazette of N. S. Wales,

* In 1852, Walker(14) described *Hemerobius australis* from New Holland

1904 (nec *M. australis* Hagen, 1858). = *M. froggatti* Banks (1: p.77, 1909).

In spite of the brevity and futility of Walker's description, which ignores almost every point of real importance, there can be no doubt that he described this common species, for three reasons. Firstly, it is the only Hemerobiid known from Tasmania (where it is quite common), except species of the genus *Drepanacra*. Secondly, the measurements given by Walker ("length 2-2½ lines, wings 5-6 lines") agree with the size of Tasmanian specimens of this insect. Thirdly, Walker's remark "veins rather few, with brown points," indicates the speckled character of the venation, one of the most noticeable characteristics of the species. Hence the more familiar names given by Banks and Froggatt must sink as synonyms of Walker's name *tasmaniae*.

This species is abundant, not only in Tasmania, but also in all, except the driest, parts of Australia. It varies greatly in size, as well as in the amount of speckling on the veins of the forewing, some specimens being very pale, others much darker and more variegated. A black mark covering *m*' and *Cu*₁ just below it, and black on the cross-veins of the outer gradate series above the lowest radial sector, appear to be constantly present in the forewing. The expanse of wing varies from 11 to 22mm., females being larger than males, and southern specimens generally larger than northern ones. More specimens of this insect exist in collections than of all the other Australian *Hemerobiidae* put together. It is one of our most beneficent insects, the larvæ destroying annually immense quantities of aphides in orchards and gardens.

M. vinaceus Gerst., is a rarer species, confined to the N. Queensland coast-line.

(p.289); his description agrees with this species fairly well for size and colouration, but his statement "radii sector primus unifurcatus, do. secundus unifurcatus, do. tertius trifurcatus" does not agree with the venation, unless his type was an anomalous specimen.

Genus NOTIOBIELLA Banks. (Plate xvi., figs. 22, 23).

Banks (1; p. 80).

Small insects, with well rounded wing-tips, forewing much longer and wider than hindwing. *Forewing* with only two radial sectors, both branched, and connected by a cross-vein running from the fork of the basal one to near the base of the distal one. *Hindwing* with false origin of Rs strongly formed, very oblique; Cu_2 absent. Outer gradate series completely absent in both wings; the inner series represented by three or four cross-veins in forewing, only one in hindwing (connecting M_1 to basal branch of Rs). Costal space of forewing more or less widened, with the recurrent veinlet present.

Genotype, *N. unita* Banks.

This genus is a highly specialised reduction from a type resembling *Psychobiella*, by the elimination of the long, outer gradate series, and the loss of one of the two radial sectors arising from near the middle of R in the forewing.

N. Banks has described five species, *N. extrema*, *N. stigmatica*, *N. unita*, *N. obliqua*, and *N. pretiosa*, the last from Fiji, the others from Middle Queensland. None of these species is known to me. Two species from S. Queensland appear to be very distinct from any described by Banks.

13. NOTIOBIELLA VIRIDIS, n.sp. (Plate xvi., fig. 22).

Total length 3, forewing 6.5, hindwing 3.8, expanse 13.5 mm.

Head yellow; eyes black; antennae yellowish shading to brown distally. Thorax and Abdomen bright yellow. Legs testaceous. Wings hyaline, with pale green venation. *Forewing* with costal space only of moderate width, but all the cross-veins densely branched along costa; distal radial sector branched only once. All the veins approaching the distal border of the wing divide into two *once only*, and each branch divides into minute forkings at the margin. Some of the veins near the base are much thickened, particularly M in forewing; Cu_1 in forewing arches up after leaving *cuf*.

Type in Queensland Museum Coll., Brisbane; taken at Brisbane on June 26th, 1911, by Mr. H. Hacker. Unique.

This very distinct and peculiar species might well form the type of a new genus, since it differs from all other species of *Notiobiella* by its green venation, very reduced hindwings, and by the peculiar thickening of the veins near the base of the wing. I prefer, however, to leave it in *Notiobiella* until we know more about that genus.

14. NOTIOBIELLA MULTIFURCATA, n.sp. (Plate xvi., fig. 23).

Total length 4, *antennae* 2·7, *forewing* 6·7 by 2·9 wide, *hindwing* 4·8 by 2·1 wide, *expanse* 14 mm.

Head, thorax, and abdomen dark brown, the last with pale creamy annuli or crescents on the segments (much shrunken). *Legs* testaceous, middle and hind tibiae strongly fusiform. *Wings* with subhyaline, rather nacreous membrane, the reflections on the forewing in the fresh specimen being pink basally, greenish near the middle, and purplish towards the tip. *Venation* dull brownish in forewing, paler in hindwing; cross-veins and forks dark brown, except the vein connecting the two radial sectors, which is black. The veins approaching the distal border of the wing fork strongly at *two levels*, so that the branches which fork minutely along the margin are very numerous and close together. In the forewing, M is very close to the basal radial sector, and is connected with it by a short cross-vein from *mf'*; the veins are not thickened near the base, and Cu₁ is not arched upwards.

Type in Coll. Tillyard. *Unique*. Taken by Dr. A. J. Turner, at Coolangatta (Tweed Heads), S. Queensland, on April 17th, 1915.

This species is closely related to *N. unita* Banks, from which it differs in the dark colouration, the broader and more closely veined costal space, and probably also in the peculiar and abundant distal forking of the veins (not mentioned by Banks in describing *N. unita*). From *N. obliqua* Banks, it differs in possessing narrower and more elongate forewings, the less broadened and less densely-veined costal space, the much darker general colouration, and larger size (expanse of *N. obliqua*, 12 mm.).

Genus CAROBIUS Banks. (Plate xvi., figs. 24, 25).

Banks (1: p. 78).

Small insects with well-rounded wing-tips. *Forewing* with only two radial sectors; the distal one arising from R near the middle of the wing-length, and giving off two posterior branches; the basal one arising from R at about one-third distance from the base of the wing, simple, but connected with M_1 (and also with R anteriorly, in the specimens examined by me) by short, strong cross-veins. *Hindwing* with a single false origin to Rs; Cu_2 absent, Cu_{1b} weakly formed. An outer gradate series present in both wings, complete in forewing, but with only four or five cross-veins in hindwing. No inner gradate series, but two cross-veins connect Cu_1 with M in forewing, and one lies between Cu_1 and Cu_2 . In forewing, Sc and R run exceedingly close together, so as to appear almost fused; the costal space is fairly broad, and the recurrent veinlet is present.

Genotype, *C. pulchellus* Banks.

Three species are known, which may be separated as follows:

- | | | | |
|----|---|--|---------------------------------|
| 1. | { | Forewings narrow, over two and a half times as long as broad | |
| | | | <i>C. angustus</i> Banks. |
| | | Forewings broader, less than two and a half times as long as | |
| | | broad..... | l. |
| { | Expanse about 13 mm. Forewings with three weakly indicated brownish waved fascie..... | <i>C. subfasciatus</i> , n.sp. | |
| | Expanse 11-12 mm. Forewings very prettily marked with | | |
| | irregular dark brown streaks and patches..... | <i>C. pulchellus</i> Banks. | |

15. CAROBIUS SUBFASCIATUS, n.sp. (Plate xvi., fig. 24).

Forewing 6 mm. *Head*, *thorax*, and *abdomen* brownish (much shrunken).

Wings: *forewing* subhyaline, lightly suffused with brown; three indistinct, wavy, transverse fascie near middle of wing, the most distal one being the broadest. Venation very pale, touched with brown on the costal cross-veins; cross-veins of the gradate series mostly dark brown; a short black streak on R

between the origin of the basal sector and the connecting cross-vein. *Hindwing* hyaline, a touch of pale brown on stigma.

Type in Coll. Tillyard, received by exchange from Queensland Agricultural Department; label "F. P. Dodd, Toowong, Brisbane," no date.

This species can be separated from *C. angustus*, not only by its broader wings, but also by the position of the brown shading of the forewings, which, in the latter species, is darkest on the hindmargin and at the apex; also the black streak on R is not present in *C. angustus*. *C. pulchellus* is a very distinct and clearly-marked species, which could not be mistaken, although there seems to be a considerable amount of variation in the shape and extent of the markings. I figure, in Plate xvi., fig. 25, a specimen in my Collection from Brisbane, which evidently belongs to this species.

Family SISYRIDÆ. (Plate xvi., figs. 26, 27; Text-fig. 9).

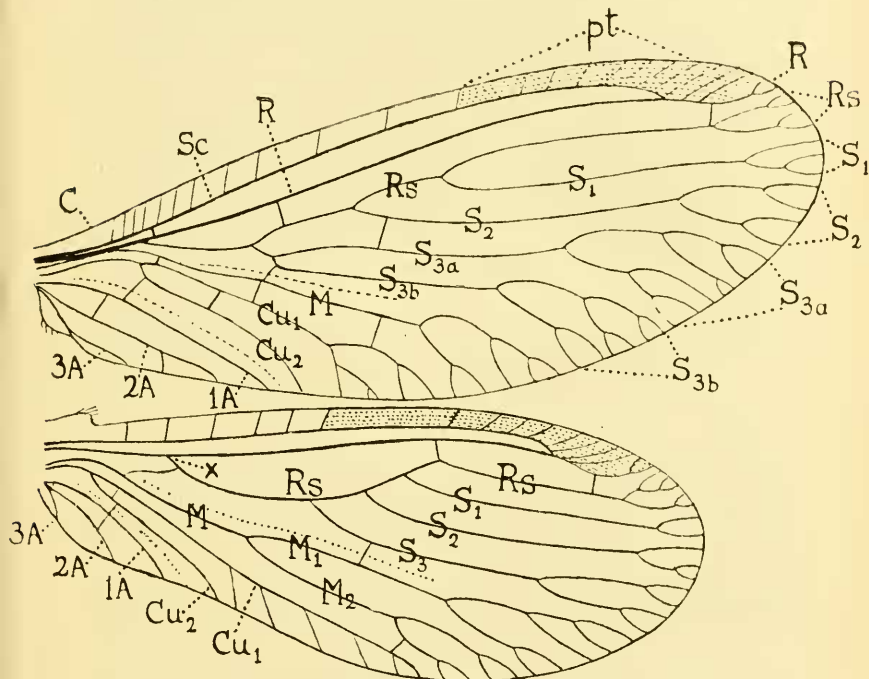
Small insects with a general resemblance to *Hemerobiidæ*. *Sc* and *R* distinctly fused distally. Only one radial sector in forewings. M unbranched in forewings, branched in hindwings. Original archaic Cu_2 present in both wings, *cuf* being close to base of wings. Hindwing with a single false origin to Rs, the basal remnant of Rs attached to M. A weak coupling-apparatus may be present. Costal space of forewings not strongly broadened, and not carrying either a recurrent veinlet or forked cross-veins. No unspecialised cross-veins.

Larva with peculiar specialised hair-like mouth-parts; lives on freshwater sponges.

As is generally recognised at present, the *Sisyridæ* owe their resemblance to *Hemerobiidæ* not to any close phyletic relationship, but rather to convergence by reduction. They must be regarded as a highly reduced offshoot from the ancient semi-aquatic *Osmylidæ*. The marks of *Osmylid* ancestry are the fusion of *Sc* and *R* distally, and the single radial sector in the forewing; while the peculiar larval mouth-parts could only conceivably be

derived from the elongated sucking mouth-parts of the *Osmyliidae*, and by no stretch of imagination from the form of mouth-parts found in the *Hemerobiidae*.

Under the name *Branchiostoma spongilla* Westwood, the larva of *Sisyr* was, for long, a puzzle to entomologists, and indeed to



Text-fig.9.—Venation of *Sisyr rufistigma*, n.sp. : S_1 - S_3 , branches of R_s ; x , false origin of R_s in hindwing.

zoologists in general. Needham(9) has reared the larva of species of both the American genera, *Sisyr* and *Climacia*, but we do not yet know whether they feed on the tissues of the sponge, or whether they use the latter only as a shelter, from which to attack other small animals. The same author has suggested for the imagines of this family the appropriate name "Spongillatiles."

Genus *SISYRA* Burm. (Text-fig.9).

Burm., Handb. Entom., ii., Part 2, p.975.

To the characters of the family we must add, for this genus, the absence of gradate series of cross-veins, and the form of the prothorax, which is not elongated. These two characters separate it from *Climacia*, which has not been found outside America.

Genotype, *S. fuscata* Fabr.

Four species of *Sisyr*a occur in Australia, and may be distinguished as follows:—

- | | | | |
|----|---|---|------------------------------|
| 1. | { | Antennae with basal joint elongated, nearly twice as long as usual..... | <i>S. punctata</i> Banks. |
| | | Antennae with basal joint of normal length..... | 1. |
| | | Antennae black throughout; forewings variegated with pale and dark patches..... | <i>S. turneri</i> , n.sp. |
| | | Antennae not black on distal half, forewings almost uniformly brown..... | 2. |
| 2. | { | Pterostigma dark brown..... | <i>S. brunnea</i> Banks. |
| | | Pterostigma reddish..... | <i>S. rufistigma</i> , n.sp. |

16. *SISYRA TURNERI*, n.sp. (Plate xvi., fig.27).*Antennae* 2·5; *forewing* 5·5; *expanse* 11·5 mm.

Head: *eyes* and *antennae* jet black, epicranium shining brown, rest of head black. *Thorax* and *Abdomen* black. *Legs* dull yellowish. *Anal appendages* in the form of a pair of strong forceps. *Wings*: *forewing* pale brown, mottled with darker patches. Pterostigma 2 mm., dark brown. An oblique triangular dark patch across middle of wing, tapering posteriorly; a second less oblique triangular dark patch below stigma, tapering anteriorly; smaller patches near base and apex; the intervening spaces pale; posterior border mostly shaded. *Hindwing* hyaline, with long, dark pterostigma.

Type in Coll. Tillyard. Four specimens taken by Dr. A. J. Turner, F.E.S., at Armidale, N.S.W., altitude 3,300 feet.

17. *SISYRA RUFISTIGMA*, n.sp. (Plate xvi., fig.26).

Antennae, ♂ 2, ♀ 2·5; *forewing*, ♂ 4·5, ♀ 5·5; *expanse*, ♂ 9·5, ♀ 11 mm.

Head rich brown; *eyes* dark brown; *antennae* with basal joint rich brown, rest dark brown. Thorax blackish; *legs* testaceous. Abdomen blackish, with no clearly visible appendages in ♂; end of abdomen in ♀ with two closely appressed processes, with flattened, upturned ends. Wings: *forewing* uniformly brown all over, with large, reddish pterostigma. Most of the cross-veins strongly darkened. All the veins shaded with darker brown, except near base and apex. *Hindwing* hyaline, with long, reddish-brown pterostigma.

Types, ♂♀, in Coll. Tillyard. A long series taken in November, 1915, along the river-side at National Park, N.S.W., by sweeping wattle-trees and bushes overhanging the water.

This species appears to be closely allied to *S. brunnea* Banks, from Queensland, but is clearly distinguished from it by the much darker body-colouration and the reddish pterostigma. *S. punctata* Banks, also from Queensland, is distinguished by its broader hindwings, and by the elongated basal joint of the antennae.

Family BEROETHIDÆ. (Plates xvii.-xviii., figs. 28-33).

Rather small, somewhat slenderly built insects; antennae short or moderate in length; wings variable in shape. No unspecialised cross-veins. Sc and R fused distally. A single Rs present in forewing, with four to eight, subparallel, and regularly arranged branches. No false origin to Rs in hindwing. M forked in both wings. Cu forked in forewing, but no true Cu₂ present in hindwing, where Cu_{1b}, however, comes off from Cu₁ not far from posterior border of wing, and runs close to, and parallel with it. Wings hairy, especially along the posterior border, which carries a fringe of long hairs. Peculiar scales, of a seed-like form, developed from modified hairs, present on some part of the wing (either on the posterior fringe, or on some of the main veins). Females with long, caudate appendages.

I propose to include in this family the two closely allied Holarctic genera, *Berotha* and *Isoscelipteron*, together with the very remarkable, new Australian genus *Spermophorella*, described below. These may be distinguished as follows:—

- Wings evenly rounded at tips; in the female, small, seed-like scales present on the main veins of the hindwing, over at least the middle portions of M_1 , M_2 , and some of the branches of Rs. *Spermophorella*, n.g. (Type, *S. disseminata*, n.sp).
- Forewings subtriangular, with the outer margin excavated; no seed-like scales on the main veins of the hindwing in the female, but flattened, seed-like scales may be present among the hairs of the posterior fringe..... 1.
1. { Only four to five branches of Rs. *Berotha* Walker.
 { Eight branches of Rs. *Isoscelipteron* A. Costa.

I doubt whether *Berotha* and *Isoscelipteron* are really generically distinct. The relationship of *Spermophorella* with these two genera may well be open to question. They represent two, isolated end-twigs of a very old stock, now nearly extinct, rather than two, closely-related offshoots of a single stem. However, I think that the agreement in venational scheme, the hairiness of the wings, and, above all, the very remarkable development of *scales* from some of the hairs of the wings, justifies us in placing them together, in spite of some very obvious differences in form of body and shape of wing. The excavate form of wing crops up continually at different places within the Neuroptera, as also in the Lepidoptera, and should not be made a bar to the recognition of closer affinities.

With regard to the development of scales, McLachlan was the first to discover them, in *Isoscelipteron* (8). He noticed that the hairs of the fringe, on the posterior margin of the wings, appeared to be very coarse and thick. On examining them with a lens, he discovered that they were, in reality, somewhat flattened scales, "like the seeds of certain Umbelliferous plants," but probably not striated. McLachlan further remarks that all the specimens which he examined were males, on account of their long, caudate appendages!

Now, in *Spermophorella*, it is the *females* which possess long, caudate appendages, and they have apparently some use in connection with the process of ovipositing. I had myself taken the females to be males at first, owing to these appendages, and was only convinced of my error when I kept the insects in glass-

bottomed pill-boxes, and noticed that those which laid eggs all possessed candidate appendages. The eggs are stalked as in *Chrysopidae*, and the stalk is formed much in the same manner. The appendages appear to be of value in helping the insect to draw out the stalk to its full length, as they act as a kind of lever to the end of the abdomen. When not in use, they are folded under it, with their tips directed forwards.

Bearing in mind, then, the foregoing facts, it seems fairly certain that McLachlan was examining *females*, and not males, of *Isoselepteron*, and that the development of the scales on the wings is confined to the females.

The scales on the hindwings of the females of *Spermophorella* are interspersed with hairs of the usual form. They are small, black, club-shaped, arising from a short stalk, and scarcely flattened at all. Their insertions in the chitin of the vein do not differ, as far as I could see, from the ordinary form of insertion of a hair. (Plate xviii., fig.30).

Genus SPERMOPHORELLA,* n.g. (Plate xvii., figs.28, 29).

Characters as given in the table above, with the following additions. No ocelli, antennæ of moderate length (a little less or greater than half the length of the forewing). Coupling apparatus of wings absent, except for a rudiment of a jugal process. Costal area of forewings exceedingly narrow at base, then widening rapidly, then narrowing towards pterostigma. Costal cross-veins branched; no recurrent, basal, costal veinlet. Pterostigma well developed in all four wings. Between Sc and R, only one cross-vein, continued downwards on to Cu₁. Rs connected to R by three cross-veins in the forewing (one under the pterostigma, just beyond the fusion of Sc with R), and by two only in the hindwing. Four or five branches of Rs in both wings. M fused basally with R, and with a cross-vein between it and R close to its origin. A single gradate series of cross-veins in the forewing, running parallel to R obliquely through the middle of the wing;

* Greek σπέρμα, seed; φερά, a bearing or producing; -ella, diminutive = "the little seed-bearer."

in the hindwing, only the lower half of the series is present, consisting of four cross-veins. Tibiæ without spurs.

Females larger and more darkly coloured than males, the latter without any scales on the hindwing.

G e n o t y p e, *Sp. disseminata*, n.sp.

The two known species may be easily distinguished as follows:

- Body-colouration pale fawn, marked with brown; antennæ less than half as long as forewing; costal cross-veins only once forked; forewing clouded irregularly with pale fawn, and one darker brown blotch; scales on hindwing of female covering nearly the whole of the wing.....*Sp. disseminata*, n.sp.
- Body-colouration blackish and dark grey; antennæ longer than half the length of the forewing; costal cross-veins much branched; forewing marked all over with dark, irregular streaks and blotches; scales on hindwing of female confined to a small area along the middle portions of M_1 , M_2 , and three branches of Rs.....*Sp. maculatissima*, n.sp.

18. SPERMOPIORELLA DISSEMINATA, n.sp. (Plate xvii., fig.28).

Total length, ♂ 5·5, ♀ 6·5; abdomen, ♂ 3, ♀ 3·5; forewing, ♂ 9, ♀ 11·5; expanse, ♂ 19, ♀ 24 mm.

Head: eyes grey, head and antennæ pale fawn, a touch of brown on epicranium. Thorax brownish, with paler markings on notum; legs pale fawn or creamy, moderately long, slender. Abdomen fawn-coloured, with an interrupted brown dorsal band. Appendages of ♀ 1·2 mm., creamy, slender, cylindrical, hairy; there are also two, pointed, triangular processes, 0·3 mm. long, closer to the base of segment 9, and nearly hidden by the long appendages.(Plate xviii., fig.31). Wings with pale, almost white, venation, which, in forewing, is speckled all over with brownish dots. Several of the costal forks darkened, also cross-veins at each end of the pterostigma. Running obliquely upward, from a point about one-third of the way along the posterior border, is a brown mark, which reaches up to M_2 ; many irregular fawn-coloured blotches and streaks also occupy the middle of the wing, especially below the pterostigma. All these markings vary much in intensity, and are more conspicuous in the females than in the males. Hindwings without markings, except a touch of

brown at each end of pterostigma; in ♀, M_1 and the three branches of Rs above it are clouded with black for a short distance below the pterostigma; scales very numerous, black, causing the hindwing to appear smoky.

Type s, ♂♀, in Coll. Tillyard (Kenthurst, N.S.W., January 23rd, 1916).

Hab.—Rocky sandstone-cliffs and gullies north and north-west of Sydney, Murphy's Creek, Kenthurst, three males and three females; Long Island, Hawkesbury River. December-February.

This very peculiar insect was discovered by Mr. Luke Gallard, of Epping, in 1914, at Kenthurst. My specimens were taken while on a visit to the original locality with Mr. Gallard. The insect rests with the wings in the usual Osmyloid position, on the fretted faces of caves and hollows in the sandstone-cliffs and escarpments. It makes no attempt to escape, its colouration rendering it absolutely invisible, unless one has previously marked the spot where one of them alights. In company with it, but less common, was the remarkable ghost-like Myrmeleontid, *Xantholeon helmsi*, whose colouration is very similar. Mr. Gallard's method of disturbing these insects was very ingenious, and I found it most effective. Using a thick, leafy branch about a yard long, cut from some tree or bush, he rustled it vigorously into every hole and corner of the cave. All the lacewings, which were touched, would flutter out from their hiding-places, and settle a yard or two further on, when they were easily pill-boxed.

Several patches of the stalked eggs were found, there being from thirty to fifty eggs in a patch, which closely resembled the fructification of a small patch of moss. The eggs are very similar to those of *Chrysopa*, but slightly rounder; both egg and stalk are cream-coloured. My three females, confined in pill-boxes, set to work almost at once to lay eggs, from twenty to fifty apiece. The egg is an elongate spheroid, length 0.75 mm., and breadth through middle 0.35 mm. (Text-fig. 10, *a*). It is supported on an excessively fine stalk, varying in length from 3 to 5 mm., and so delicate that it does not always support the egg firmly, but may bend with the weight of it. This stalk is hollow throughout,

except at the extreme base and tip. It is stoutest at its base, where the diameter of the cross-section is 0.013 mm., that of the lumen being 0.005 mm. It then tapers rather rapidly until, at about one-fifth of the total length from the base, it is only 0.007 mm. wide, with a lumen of about 0.003 mm. It then continues to taper more gradually, reaching a width of only 0.005 mm., with a lumen of only 0.002 mm., close up to the egg.



Text-fig. 10.*

During the embryonic period, the egg becomes curiously speckled, until it appears an absurd-looking object. This peculiar marking is due to the early development of a pair of dark patches of pigment on alternate segments of the embryo. As the latter is very elongated, it becomes curved round the egg, so that a double band of five pairs of dark spots is clearly visible (as shown in Text-fig. 10, *b*). These spots appear on the fourth day, and are followed, on the fifth, by a pair of smaller spots, marking the position of the mesothorax. The unpigmented prothorax and head lie curved around the anterior pole of the egg, which, therefore, appears unspotted. On the eighth day, smaller mid-dorsal spots appear on all the segments.

The young larva (Plate xviii., fig. 32) emerges on the tenth day after the egg is laid. It is a long, slender creature, some 2.5 mm. in length, and exceedingly active. It descends the egg-stalk at once, and moves off at a rapid pace, with the looping gait of a *Geometer* caterpillar, using its small legs and anal clasper for walking. Unfortunately, I could find no food suitable for these peculiar larvæ; so, after fixing and mounting a number of them, I let the rest go free on the rocks at the bottom of my garden. The only food which suggests itself to me as at

* Stalked eggs of *Spernophorella disseminata*, n.sp., ($\times 12.5$): *a*, freshly laid; *b*, five days old. Profile-view, showing the five pigment-spots on one side of embryo only. The sixth, smaller spot indicates the position of the mesothorax.

all likely is the caterpillars of the small Pyralid moths which inhabit the caves and rocks so abundantly. These caterpillars are not known for certain, but it is supposed that they are nocturnal, and feed upon the patches of lichen on the rocks. As will be seen from the figure in Plate xviii., fig.32, the larva of *Spermophorella* might easily pass unnoticed amongst such caterpillars. It is probable that its great activity and protective colouration enable it to discover the colonies, or hiding-places, of the Pyralid larvæ, and to dwell with them without causing them any alarm. They could then be attacked and eaten at leisure. The mouth-parts of the larvæ are very peculiar, adapted for sucking, but the mandibles are neither elongated, as in *Osmiulidae*, nor curved, as in *Chrysopidae* and *Hemerobiidae*.

The young larva, when hatched, has the head, prothorax, and legs cream-coloured, except for the black eye-spots, and a touch of pale brown on the head and neck. The metathorax and the even segments of the abdomen, from the second to the eighth, are deeply shaded with brown, each carrying two, very large, lateral blotches, and a smaller, central, dorsal patch. The mesothorax and the odd segments of the abdomen, from the first to the seventh, are cream-coloured, with a small, central, dorsal patch of brown. The ninth abdominal segment, carrying the anal clasper, is pure cream-coloured.

The figure in Plate xviii., fig.32, shows the larva after being fixed and mounted. In actual life, however, when at rest, it is considerably more elongated, and, when travelling quickly along, it extends itself to a great length.

The mouth-parts (Plate xviii., fig.33) are rather peculiar. The *mandibles* (*md*) are broad at the base, about as long as the head, and tapering to a point, the inner margin being strongly curved. They are strongly grooved beneath, the maxillæ fitting into the grooves. The *maxilla* (*mx₁*) resemble the mandibles, but are less strongly chitinised, narrower at the base, and grooved on the upper surface. The combined maxilla and mandible form a sucking-tube whose lumen is very nearly straight, except at the base. There are no maxillary palpi. The *labial palpi* (*lp*)



are placed close together, three-jointed, and slightly longer than the mandibles. The basal joint is short and moderately narrow, the second longer, broader, and somewhat fusiform, the third long, very narrow and seta-like. The *labrum* (*lr*) is merely a weak, slightly bifid projection between, and slightly above, the mandibles.

The head itself is curiously elongate, the black eye-spots being placed laterally close up to the anterior border. The *antenna* (*ant*) are situated just in front of the eye-spots, above the mandibles, and closely resemble the labial palpi. They are, however, longer, and four-jointed. The basal joint is short and fairly thick; the second joint is somewhat broader and slightly fusiform as regards its distal two-thirds, but the basal third is narrower, and the outer border is slightly dentate or ridged at one-third from the base; this ridging probably representing the beginning of the formation of a number of small segments from this joint. The third joint is long and very slender, the fourth merely a sharply-pointed, seta-like termination. The *neck* or *microthorax* (*mc*) is very conspicuous, elongated and rather narrow.

Larval Types in Coll. Tillyard. Three, mounted on one slide; hatched on February 2nd, 1916, from eggs laid by the type ♀, on January 23rd, 1916.

19. *SPERMOPHORELLA MACULATISSIMA*, n.sp. (Plate xviii., fig. 29).

Total length, ♂ 5·3, ♀ 7; *abdomen*, ♂ 3, ♀ 3·8; *forewing*, ♂ 9·5 ♀ 11·5; *expanse*, ♂ 19·5, ♀ 23·5 mm.

Head hairy, dark grey; *eyes* blackish; *antennae* brownish, more than half as long as forewing. *Thorax* dark greyish-black, prothorax hairy, metathorax paler on posterior border of notum. *Legs* slender, hairy, testaceous, spotted with blackish on femora, tibiae, and apices of tarsal joints. *Abdomen* blackish, with a pair of grey-brown spots placed latero-dorsally on each segment near its apex. *Appendages* of ♀ closely resembling those of *Sp. disseminata* ♀ in size and shape. Colour testaceous. *Wings*: *forewing* with venation speckled alternately with straw-colour and black, the black spots and markings being very frequent: many of the small, branching veins

around the wing-border strongly outlined and thickened with black. The whole of the forewing is heavily marked with irregular greyish-black streaks, spots, and blotches, tending to form oblique fasciæ across the wing. *Pterostigma* well-formed in both wings, spotted with black along costa. Tip of forewing more evenly rounded than that of *Sp. disseminata*, and costal area of same wing more abruptly dilated near the base; costal cross-veins more irregularly placed, and much branched. *Hind-wing* not speckled, venation testaceous along Sc, R, and Rs, dark grey to black on the rest of the wing; in ♀, M₁, M₂, and the three branches of Rs above them, are provided with scales over a moderate-sized area in the middle of the wing.

(*Note.* — In figuring the two species of *Spermophorella*, I have omitted the short, bristly hairs which are present on all the veins, in order to show up the venation more clearly.)

Types: ♂♀, in Coll. Tillyard (Brisbane; September 23rd, 1915).

Hab. — One-Tree Hill, Brisbane: two males and two females, taken on a hot afternoon, disturbed while resting on the face of a cutting about half-way along the road to the summit. September.

The four specimens captured were put separately into pill-boxes alive. The same evening, both females laid a number of stalked eggs, from twenty to thirty apiece. These were very similar to those described for *Sp. disseminata*, but the eggs had a slight greyish tinge. They hatched on the tenth day after being laid. During the embryonic period, the eggs darkened to a semiopaque grey, through which a double band of black markings made itself visible on the developing larva. The young larva, when hatched, resembled that of *Sp. disseminata* in size, shape, and actions; but it was of quite a different colour, the ground-colour being pale grey, with large black spots on alternate segments. It would seem, then, that this larva inhabits the darker rocks which are so common around Brisbane, and probably preys upon Lepidopterous caterpillars, which feed on the lichens of the rocks. I was unable to obtain suitable food for my larvæ, and they all died.

Family TRICHOMATIDÆ,* fam.nov.

(Plate xviii., fig.34; Plate xix., fig.35)

Small or moderate-sized insects, with the whole body, and the veins and margins of the wings, densely clothed with thick hairs. Head moderately wide, the basal joint of the antennæ much enlarged, sometimes hypertrophied. Wings variable in shape. Costal area of forewing narrow: recurrent veinlet at base either absent or rudimentary. In forewing, Sc and R run close together, but remain quite separate throughout their length: cross-veins between them either absent, or one only. In the hindwing, Sc and R also remain quite separate, but are somewhat further apart. A single radial sector present in both wings, with 3-5 branches. M fused basally with R, and forked in both wings. Cu forked in forewing, simple in hindwing (original Cu_2 absent). No unspecialised cross-veins present, there being only a single (distal) gradate series in forewing, two or three cross-veins connecting Rs with R, and a few others placed in suitable positions for supporting the main veins: in hindwing, very few cross-veins, and no gradate series. Along posterior border of wing, there are numerous, short branches from the main veins; this border also carries a dense fringe of very long hairs, which may even exceed in length the width of the wing itself. A small coupling apparatus, with frenulum, present at bases of wings. No false origin to Rs in hindwing.

I propose this family for the reception of two extraordinary insects recently captured at light, one by Mr. O. Lower, at Broken Hill, N.S.W., the other by Dr. A. J. Turner, at Brisbane. Though very different in appearance, these insects are united by a large number of common characters. They also differ from all Neuroptera, except the *Chrysopidae*, in combining the absence of fusion of Sc and R with the presence of only one Rs in the forewing. Their differences from *Chrysopidae* are so great and obvious as scarcely to need commenting upon, since they possess none of the striking specialisations of that family. They differ from all other Neuroptera in the immense development of

* Greek *τρίχωμα* = a shock of hair.

hairs upon the body and wings; indeed, I know of few Trichopterous insects even that have such a hairy appearance.

Two genera are represented, which may be separated as follows,—

Wings of moderate breadth, slightly falcate, the margin below the apex being slightly excavated. Antennæ with basal joint not unduly enlarged
Genus *Trichoma*, n.g. (Type, *T. gracilipenne*, n.sp.).

Wings elongate, excessively narrow, fore and hind margins parallel, apex almost in line with hind margin. Antennæ with greatly hypertrophied basal joint.....
Genus *Stenohiella*, n.g. (Type, *St. hirsutissima*, n.sp.).

Genus TRICHOMA, n.g. (Plate xix., fig.34).

Characters as given above in the generic key, with the following additions. Size moderate (about 1 inch expanse), antennæ nearly as long as forewing; three branches to Rs in forewing, four in hindwing. In hindwing, Cu₁ runs parallel to posterior margin from just above the ending of 1A to the point where M₂ branches, and then curves down to meet the wing-border just before the tornus; from this part of Cu₁, oblique, much-branched veinlets descend to the border; Cu₁ is also connected with 1A, from just above the end of the latter, by a vein running back to 1A parallel with the border. Costal cross-veins in forewing all branched before pterostigma; the most basal one is tending to become a true, recurrent veinlet.

Genotype, *T. gracilipenne*, n.sp.

20. TRICHOMA GRACILIPENNE, n.sp. (Plate xix., fig.34).

Total length, 10; abdomen, 6; forewing, 12; expanse, 25 mm.

Head dark brown, eyes very dark; antennæ with basal joint dark, hairy, the rest a medium brown, barely pectinate. Thorax: prothorax dark brown, hairy, divided into two by a transverse, median groove. Pterothorax dark brown, about as wide as head, moderately hairy, rather shiny, with pale brown markings along the sutures and posterior border. Legs of medium length, hairy, brown; tibiæ without spurs: tarsi 5-jointed, the basal joint nearly as long as the other four together. Abdomen dark brown, hairy; appears narrow when viewed dorsally, broad in

profile (probably cylindrical and of moderate breadth in life); two, short, subconical, anal appendages present. (Sex indeterminate). Wings subhyaline, clouded with pale brown. Veins and hairs mostly brown, but a very delicate effect of silvery-grey patches is produced in forewing by the areas on either side of the gradate series, and a few smaller patches along M and the margins, possessing a whitish venation with whitish hairs upon it; this effect is heightened by patches of dark brown along the gradate series, on the pterostigma, and irregularly round the wing-margins. The hairs of the fringe are chiefly pale brownish or brownish-grey, but there are a number of conspicuous patches of dark brown hairs, especially along the posterior margin, in both wings. *Cross-veins in forewing*: five in the gradate series from M_2 up to R; three between R and R_s (inclusive of the uppermost one of the gradate series); one below R_s just proximal from the gradate series; one from base of R_s to M; one between M_1 and M_2 , and a second just below it; also an oblique one supporting the wide forking of M_2 ; one between Cu_1 and Cu_2 , and one between 1A and 2A not far from base. *Cross-veins in hindwing*: one between Sc and R above middle of wing; one only, distad from this, between R and R_s , and two exactly below this, one above and one below M_1 ; an oblique one supporting the forking of M_2 ; one connecting m' to R_s ; and one from base of M to Cu.

Type in Coll. Tillyard. Unique. Taken at light by Mr. O. Lower, at Broken Hill, N.S.W. Undated.

Genus STENOBIELLA, n.g. (Plate xix., fig.35).

Characters as given in the generic key, with the following additions. Size rather small (expanse about three-quarters of an inch); antennæ about two-thirds the length of the forewing; three branches to R_s in both wings. In hindwing, Cu_1 comes very close to posterior margin at the level of the ending of 1A, and thence onward, for about one-third of the wing-length, runs parallel to, and just above, the wing-margin, giving off a number of exceedingly short, unbranched veinlets to it; Cu_1 is connected with 1A by a cross-vein. Costal cross-veins in forewing branched

only to about half the wing-length from the base. Owing to the narrowness of the wing, all the main veins tend to assume a nearly parallel course: the hindwing has only six specialised cross-veins, three near the base, and three just beyond the middle. Fringe of posterior margin very long: in hindwing, near the base, its hairs are longer than the wing is wide.

Genotype, *St. hirsutissima*, n.sp.

21. STENOBIELLA HIRSUTISSIMA, n.sp. (Plate xix., fig. 35).

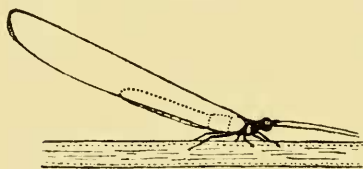
Total length, 5; *abdomen*, 2.5; *forewing*, 9; *expanse*, 18.5 mm.

Head blackish, hairy, touched with brown on epicranium; some of the hairs pale greyish: *eyes* dark grey: *antennae* black, the basal joint 0.8 mm. long, swollen, very hairy. *Thorax* hairy, blackish, touched with dark brown; some pale grey hairs on prothorax. *Legs* short, dull brownish-grey: tibiae without spurs; tarsi with five short joints. *Abdomen* very short, slender, hairy, blackish, touched with pale grey apically on each segment. *Appendages* very minute, conical. (Sex indeterminate). *Wings* subhyaline, clouded with dull greyish-brown; forewing with slightly darker patches, irregularly placed around the margins and along the gradate series; three indistinct patches along Rs, and two lying upon Cu; apex slightly darkened. *Pterostigma* slightly darkened in both wings; fringes uniformly dark grey. *Cross-veins in forewing*: five in the gradate series from M_2 up to R; another from R to Rs a little proximad to the top vein of the gradate series: one between R and M near base, another between M and Cu_1 just distad from *cu*₁, and one below it from Cu_2 to 1A; two more placed more distally between M_2 and Cu_1 , and one joining Cu_1 to the upper branch of Cu_2 . *Cross-veins in hindwing*: three at about the same level, distad from middle of wing, one from R to Rs, one from M_1 upwards to the lowest branch of Rs, and one from M_2 to Cu_1 ; three more near the base, one from Rs to M, one, nearer still, from M to Cu, and one, more distally placed, from Cu_1 to 1A. Numerous, small veinlets descend upon the posterior margin in both wings.

Type in Coll. Tillyard. **Unique**. Taken at light by Dr. A. J. Turner, at his house at Sherwood, near Brisbane. November 10th, 1915.

This extraordinary insect is clearly a highly specialised offshoot from the more normal form represented in *Trichoma*. The very narrow and elongated wings, with long fringes, mark it off from all other Neuroptera.

Postscript, added May 1st, 1916.—Since the completion of this paper, I have received from Mr. Luke Gallard, of Epping, N.S.W., a living specimen of a fine new species of *Stenobiella*, which he captured while beating bushes and low trees at Kenthurst, N.S.W. This remarkable insect, when alive, rests with its wings



Text-fig. 11.*

the end of its body. When resting on a twig, the antennae are directed straight forwards, while the body and wings are held rigidly at an angle of about 30° to the plane of rest. As the wings

are a dull brownish colour with irregular grey markings and numerous hairs, the effect produced is that of a broken-off stump of a small side-twig. The principal factor in the success of this disguise is, of course, the length of the wings. A pencil sketch, which I made of the insect at rest, is reproduced in Text-fig. 11. I append a short description of this new species, which I have dedicated to its discoverer.

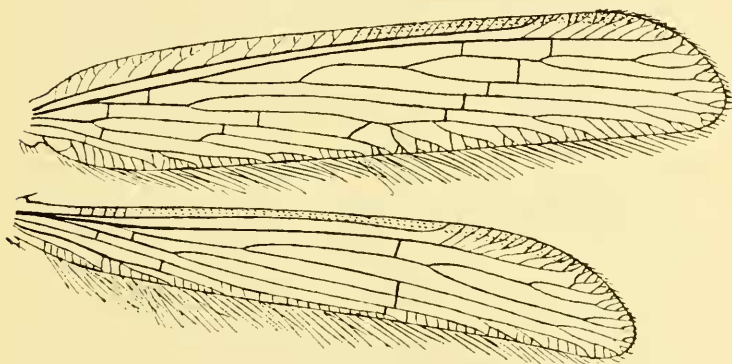
STENOBIELLA GALLARDI, n.sp. (Text-figs. 11-12).

Total length, 5·5; *abdomen*, 2·8; *forewing*, 9·3; *hindwing*, 8·4 mm. [Measurements of the dried specimen; the living insect was considerably larger]. Sex indeterminate.

Head dark brown, touched with grey; *eyes* dull blackish; *antennæ* 5 mm. long, dark brown, basal joint 0·8 mm., very hairy, not quite so much enlarged as in *St. hirsutissima*. *Thorax* and legs dark brown. *Abdomen* brownish black. *Wings*

* *Stenobiella gallardi*, n.sp., at rest on a twig, to show natural position of holding wings and abdomen (drawn in outline only); ($\times 3\frac{2}{3}$).

dull semitransparent brown, hairy, the forewing irrorated with grey in irregular patches, and with a few, indistinct, dark brown spots; a pale spot on the costa just beyond pterostigma, and an oblique, faint, dark band along the gradate series. *Shape* much as in *St. hirsutissima*, but forewing slightly wider in comparison with length, hindwing narrower at base and more broadened towards tip. *Fringe* of uniformly dark brown hairs, not so long as in *St. hirsutissima*. *Venation* (Text-fig.12) broadly as in *St. hirsutissima*, but differing in the following points. In both



Text-fig.12.—Venation of *Stenobiella gallardi*, n.sp.: ($\times 9$).

wings, Sc is shorter; and hence there are more branch-veins running up to C from distal end of R. In forewing, the cross-vein from near the distal end of Cu_1 up to M_2 is *strongly oblique* (normal in *St. hirsutissima*); in hindwing, there is an extra cross-vein placed distally between M_1 and M_2 , exactly in line with the one above it.

Hab.—Kenthurst, N.S.W. Taken by Mr. Gallard on April 23rd, 1916.

Type in Coll. Tillyard. Unique.

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- M. acuminata*, n.sp., *Carobius*, n.g., *C. angustus*, n.sp., *C. pulchellus*, n.sp., *Psychobiella*, n.g., *Ps. sordida*, n.sp., *Notobiella*, n.g., *N. externa*, n.sp., *N. stigmatica*, n.sp., *N. unida*, n.sp., *N. obliqua*, n.sp., *N. pretiosa*, n.sp. (Fiji).]
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EXPLANATION OF PLATES XII.-XIX.

Plate xii.

Fig. 1.—*Ithone fulva*, n.sp.; ($\times 4$).

Fig. 2.—*Ithone fulva*, n.sp.; head, prothorax, and forelegs, viewed from in front; ($\times 6$); (*ant*, antennæ; *cl*, clypeus; *cx*₁, coxa of foreleg; *e*, eye; *ep*, epiceranium; *g*, gena; *lp*, labial palp; *lr*, labrum; *md*, mandible; *mcp*, maxillary palp; *pr*, prothorax).

Fig. 3.—*Ithone fulva*, n.sp.; tibial spines; ($\times 13$); *sp*, spines; *ti*, tibia; *ts*, basal joint of tarsus.

Fig. 4.—*Ithone fulva*, n.sp.; appendages of male, dorsal view; ($\times 8$); *i*, inferior; *s*, superior.

Fig. 5.—*Ithone fulva*, n.sp.; appendages of male, profile view; ($\times 8$); *i*, inferior; *s*, superior.

Fig. 6.—*Ithone fulva*, n.sp.; appendages of male, posterior view; ($\times 8$); *i*, inferior; *s*, superior.

Fig. 7.—*Ithone fusca* Newman; appendages of male, dorsal view; ($\times 8$); *i*, inferior; *s*, superior.

Fig. 8.—*Ithone fusca* Newman; appendages of male, profile view; ($\times 8$); *i*, inferior; *s*, superior.

Fig. 9.—*Ithone fusca* Newman; appendages of male, posterior view; ($\times 8$); *i*, inferior; *s*, superior.

Plate xiii.

Fig. 10.—*Drepanopteryx phalaenoides* (Linn.). Venation; ($\times 8$).

Fig. 11.—*Drepanopteryx phalaenoides* (Linn.). Fenestella; ($\times 20$).

Fig. 12.—*Drepanocera humilis* (McLach.). Venation; ($\times 8$).

Fig. 13.—*Drepanocera humilis* (McLach.). Fenestella; ($\times 20$).

Fig. 14.—*Drepanocera humilis* (McLach.). Third or most posterior lunule; ($\times 20$).

Venational notation as usual. In addition, *cuf*, cubital fork; *cuf'*, secondary cubital fork; *fn*, fenestella; *jl*, jugal lobe; *jp*, jugal process with frenulum; *lu*, lunule; *S*₁-*S*₈, branches of *R*s in hindwing; *x*, first false origin of *R*s in hindwing; *x'*, second ditto.

Plate xiv.

Fig. 15.—*Drepanocera instabilis* (McLach.). Venation; ($\times 8$).

Fig. 16.—*Drepanocera hardyi*, n.g. et sp. Venation; ($\times 8$).

Fig. 17.—*Drepanocera froggatti*, n.g. et sp. Venation of apical third of forewing; ($\times 8$).

Fig. 18.—*Drepanomina gibbosa*, n.g. et sp. Venation; ($\times 6$).

Fig. 19.—*Drepanocera humilis* (McLach.), ♂. Coupling apparatus of the wings; *fr*, frenulum; *jl*, jugal lobe; *jp*, jugal process; ($\times 32$).

Plate xv.

Fig. 20.—*Oxybiella bridwelli*, n.g. et sp.; ($\times 10$).

Fig. 21.—*Psychobiella fusca*, n.sp.; ($\times 10$).

Plate xvi.

Fig. 22.—Wings of *Notiobiella viridis*, n.sp.; ($\times 9$).

Fig. 23.—Wings of *Notiobiella multifurcata*, n.sp.; ($\times 9$).

Fig. 24.—Wings of *Carobius subfasciatus*, n.sp.; ($\times 9$).

Fig. 25.—Wings of *Carobius pulchellus* Banks; ($\times 9$).

Fig. 26.—Wings of *Sisyra rufistigma*, n.sp.; ($\times 9$).

Fig. 27.—Wings of *Sisyra turneri*, n.sp.; ($\times 9$).

Plate xvii.

Fig. 28.—*Spermophorella disseminata*, ♀, n.g. et sp.; ($\times 7$).

Fig. 29.—*Spermophorella maculatissima*, ♀, n.g. et sp.; ($\times 7$).

Plate xviii.

Fig. 30.—*Spermophorella disseminata*, ♀, n.g. et sp. Small portion of a vein from hindwing, showing hairs and seed-like scales; ($\times 90$).

Fig. 31.—*S. disseminata*, ♀, n.g. et sp. Appendages, profile view; ($\times 14$).

Fig. 32.—*S. disseminata*. Newly-hatched larva; ($\times 32$).

Fig. 33.—*S. disseminata*. Head of ditto; ($\times 90$): *ant*, antenna; *lp*, labial palpi; *lr*, labrum; *mc*, microthorax or neck; *md*, mandible; *mx₁*, maxilla.

Fig. 34.—*Trichoma gracilipenne*, n.fam., gen. et sp.; ($\times 7$).

Plate xix.

Fig. 35.—*Stenobiella hirsutissima*, n.fam., gen. et sp.; ($\times 15$).